Archives of

PHYSICAL MEDICINE AND REHABILITATION

(Formerly Archives of Physical Medicine)

Official Journal
American Congress of Physical Medicine and Rehabilitation
American Society of Physical Medicine and Rehabilitation

EDITORIAL BOARD

WALTER M. SOLOMON, M.D., Chairman
Cleveland, Ohio

EARL C. ELKINS, M.D.
Rochester, Minn.

FRED B. MOOR, M.D.
Los Angeles, Calif.

FREDERIC J. KOTTKE, M.D.
Minneapolis, Minn.

GEORGE M. PIERSOL, M.D.
Philadelphia, Pa.

ARTHUR L. WATKINS, M.D.
Boston, Mass.

Copyright, 1953, by The American Congress of Physical Medicine and Rehabilitation

VOLUME XXXIV FEBRUARY, 1953 NO. 2

ANNUAL SESSION · CHICAGO · AUGUST 31-SEPTEMBER 4, 1953

American Congress of Physical Medicine and Rehabilitation

31st Annual

Scientific and Clinical Session

and

Instruction Seminar

August 31 through September 4, 1953

Official Headquarters

THE PALMER HOUSE

Chicago

EXECUTIVE OFFICES

30 NORTH MICHIGAN AVENUE CHICAGO 2, ILLINOIS

INSTRUCTION SEMINAR

In Conjunction with the

31st Annual Scientific and Clinical Session

AMERICAN CONGRESS OF PHYSICAL MEDICINE AND REHABILITATION

August 31 through September 4, 1953

THE PALMER HOUSE CHICAGO

WATCH THE ARCHIVES FOR ANNOUNCEMENT OF SUBJECT MATTER

Physicians and those therapists registered with the American Registry of Physical Therapists or the American Occupational Therapy Association will be permitted to enroll for the instruction seminar. The charge for a single lecture is $2.00; for a full schedule of eight lectures, $15.00.

For full information and application form address

AMERICAN CONGRESS OF PHYSICAL MEDICINE AND REHABILITATION

30 North Michigan Avenue Chicago 2, Illinois

MEDCOLATOR

USES IN ELECTRICAL MUSCLE STIMULATION ADJUNCT THERAPY

1. FOR
   - . . . Strains
   - . . . Sprains
   - . . . Dislocations
   - . . . Other trauma of muscle and skeletal system

   Assisting through muscle contraction in:
   a. The Removal and Resolution of Exudates
   b. Reduction of Edema
   c. Stimulation of Blood and Lymph Flow
2. To Retard Atrophy
3. For Muscle Re-education
   . . . It helps to Reestablish Muscle Sense
4. To Help Regain and Preserve Mobility and Function of Muscles

An Ancillary to
Massage . . . Drugs . . . Heat Therapy . . . Or May Be Used Alone

Write for literature and demonstration

MEDCO PRODUCTS CO.

3607 E. ADMIRAL PLACE, TULSA 12, OKLA.
P. O. Box 3275, Dept. T.

THE KABAT - KAISER INSTITUTE

at Vallejo, California, announces three months post-graduate courses for physical therapists in techniques of neuromuscular re-education. Physical therapists must be members of the American Physical Therapy Association, members of the American Registry of Physical Therapists or qualified foreign physical therapists. Courses start Jan. 1st, April 1st., July 1st and Oct. 1st. Number of students accepted is limited. Certificate given upon successful completion of the course. Tuition: $150.

Applicants should communicate with:

Margaret Knott
Chief Physical Therapist
KABAT-KAISER INSTITUTE
VALLEJO, CALIFORNIA

OPPORTUNITIES AVAILABLE

(Please send for our Analysis Form so we may prepare an Individual Survey for you.)

WANTED — PHYSIATRIST: head department, new hospital, 325 beds; large city, university center, Midwest. For further information, please write Burneice Larson, Director, Medical Bureau, Palmolive Building, Chicago.

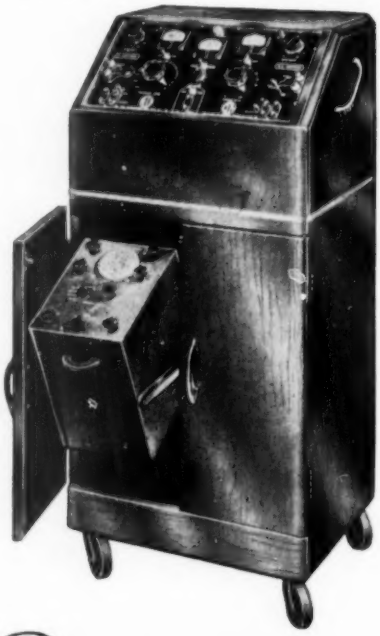
WANTED — PHYSICAL THERAPISTS: (a) Chief; group of 17 specialists, Diplomates or eligible; university town, short distance from Chicago. (b) Student health department; state university; duties consist of providing physical therapy for in and out-patients of 100-bed hospital and students from student health clinic. (c) Hospital for crippled children; residential town near Chicago. (d) Chief; polio experience desirable; 250-bed hospital; air-base; California 26 men to each woman. (e) Assistant supervisor and two staff therapists; organization operating treatment and training center for physically handicapped; large city, university medical center. (f) Chief; qualified to direct staff of ten technicians, large long established department, 49,000 treatments annually; important hospital; East. (g) Speech therapist, occupational therapist and physical therapist; new convalescent home for crippled children; college town, Southwest.

For further information, regarding these opportunities, please write Burneice Larson, Medical Bureau, Palmolive Building, Chicago.

TECA CD4P-S

a low price generator with variable frequencies for conventional low-volt therapy

- Muscle Stimulation
- Ion-Transfer Therapy
- Electro Diagnosis
- Medical Galvanism



AVAILABLE CURRENTS:

A. C., from 18 to 3000 cycles per second in sine wave and square wave.

D. C., straight and any desired degree of pulsation.

A. C. and D. C. PULSES of 1 m/s duration (may be regulated from 1 to 100 pulses per second).

ALL CURRENTS SURGING (except pulses) from 6 to 60 surges per minute.

SUPERIMPOSED CURRENTS: any alternating current can be superimposed on any direct current, or vice versa.

OSCILLOSCOPE OPTIONAL: CD4P-S may be equipped with a 3" oscilloscope.

TWO CIRCUITS: separate circuits and controls for A. C. and D. C. for easier operation and wider range of application.

For literature, price, demonstration, write Dept. A-3.

TECA CORPORATION 139 EAST 23RD ST., NEW YORK 10, N. Y.

Simple To Operate
Reliable • Efficient

HYDROCOLLATOR

No Wringing

No Dripping

Steam PACK

30 MINUTES MOIST HEAT WITH EACH APPLICATION

Local MOIST HEAT can most effectively be applied with the HYDROCOLLATOR STEAMPACK. Simply heat in water, lift out, wrap in towel, and apply. Special heat retaining gel filler absorbs and holds water to give at least 30 minutes effective moist heat with each application. Packs can be used over and over. Well designed to fit any body contour. Used in leading hospitals and clinics.

WRITE FOR LITERATURE AND PRICES

CHATTANOOGA PHARMACAL COMPANY, Inc.

CHATTANOOGA 5, TENNESSEE

HYDROCOLLATOR MASTER UNITS

FOR HOSPITAL AND CLINIC

6-Pack Model 55

Automatically maintains a constant supply of ready-to-use Hydrocollator Steam packs. Temperature is thermostatically controlled. Heated packs are easily taken to the patients, thus you can treat several patients at the same time. No need to transport patients to the heat source and await their turn.

No plumbing connections. Simply plug into your electrical outlet. Sturdy, handsome stainless steel construction.

OFFICIAL INSIGNIA

THE AMERICAN REGISTRY OF PHYSICAL THERAPISTS

The PIN

(About Actual Size)

The official pin is made of 1/10 carat gold with purple enamel trim.

$5.40

(Including Federal Tax)

The EMBLEM

(Two-thirds Size)

Gold and purple on white cloth. Color fast. Each,

25c

The pin or the emblem may be obtained with "S" or "J". Cost must accompany order. (Prices subject to change without notice.)

AMERICAN REGISTRY PHYSICAL THERAPISTS

All Prices Subject to Change Without Notice.

Address all communications to

AMERICAN REGISTRY OF PHYSICAL THERAPISTS
30 N. Michigan Ave. Chicago 2

Georgia Warm Springs Foundation GRADUATE COURSE

Physical Therapy and Occupational Therapy in the Care of Poliomyelitis

This course is open to graduates of approved schools in physical therapy and occupational therapy. Such graduates must be members of the American Physical Therapy Association and/or the American Registry of Physical Therapists and Occupational Therapy Association.

Tuition: None. For Scholarship to Cover Transportation and Maintenance, Contact National Foundation for Infantile Paralysis, 120 Broadway, New York 5, New York.

Entrance Dates: First Monday in January, April, July and October.

Duration of Course: The Course is divided into two parts:

Part I. Over-all care of convalescent polio with particular emphasis and special training in muscle testing and muscle reeducation.

Part II. Particular emphasis and special training in functional testing and functional retraining.

Each Part lasts three months and only selected students who have completed Part I will be admitted to Part II. All students applying for Part I must be willing to remain through Part II if selected.

For Information Write:

ROBERT L. BENNETT, M.D.
Georgia Warm Springs Foundation
WARM SPRINGS, GEORGIA

AERO-KROMAYER
by HANOVIA

For accurate control in local ultraviolet application

Designed, developed and engineered specifically for highly concentrated ultraviolet therapy under accurate focus and dosage, the Aero-Kromayer has a wide field of clinical usefulness.

The Aero-Kromayer is completely air-cooled—operates in any desired position while delivering a constant, high-intensity output—and its various applicators are designed for any skin surface and orificial irradiation that may be required.

Just off the press—new booklet, "Ultraviolet Radiations in Eye, Ear, Nose and Throat Conditions," free on request. Write Dept. 306-B

HANOVIA *Chemical & Mfg. Co., Newark 5, N. J.*

REGIONAL OFFICERS
AMERICAN CONGRESS OF PHYSICAL MEDICINE AND REHABILITATION

EASTERN SECTION—Chairman, Thomas P. Hines, Branford, Conn.; Secretary, Hermann B. Arnold, Beecher Road, Woodbridge, New Haven 15, Conn.

States represented: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island and Vermont.

MIDWESTERN SECTION — Chairman, Miland E. Knapp, Minneapolis, Minn.; Secretary, George K. Stillwell, 2333 Priscilla Avenue, St. Paul 8, Minn.

States represented: Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota and South Dakota.

WESTERN SECTION — Chairman, Leonard Yamshon, Los Angeles, Calif.; Secretary, Joseph E. Maschmeyer, 19 W. Palm Drive, Arcadia, Calif.

States represented: California and Nevada.

NORTHWESTERN SECTION—Chairman, Everill W. Fowlks, Oswego, Ore.; Secretary, Sherburne W. Heath, Jr., VA Hospital, 4435 Beacon Avenue, Seattle 8, Wash.

States represented: Idaho, Montana, Oregon and Washington.

ROCKY MOUNTAIN SECTION — Chairman, Harold Dinken, Denver, Colo.; Secretary, Jerome W. Gersten, Univ. of Colorado Medical Center, 4200 E. Ninth Avenue, Denver 7, Colo.

States represented: Arizona, Colorado, New Mexico, Utah and Wyoming.

CENTRAL SECTION — Chairman, Ralph E. Worden, Columbus, Ohio; Secretary, Frederic B. House, 1942 Steere Place, Ann Arbor, Mich.

States represented: Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia and Wisconsin.

SOUTHERN SECTION — Chairman, Lt. Col. Charles D. Shields, Ft. Sam Houston, Texas; Secretary, Duane A. Schram, Gonzales Warm Springs Foundation, Gonzales, Texas.

States represented: Arkansas, Louisiana, Mississippi, Oklahoma and Texas.

SOUTHEASTERN SECTION — Chairman, George D. Wilson, Asheville, N. C.; Secretary, Herbert W. Park, Baruch Center of Physical Medicine and Rehabilitation, Medical College of Virginia, Box 47, Richmond 19, Va.

States represented: Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee and Virginia (D. C.).

MEAD HOME TREATMENT STIMULATOR

Interrupted Direct (Galvanic) Current

For Prolonged Electrical Stimulation of Denervated Muscle

Patients with peripheral nerve disorders who could benefit from daily electro-therapy often get only token treatment because of the expense and inconvenience of daily office visits. Here is the answer to this need — intensive treatment

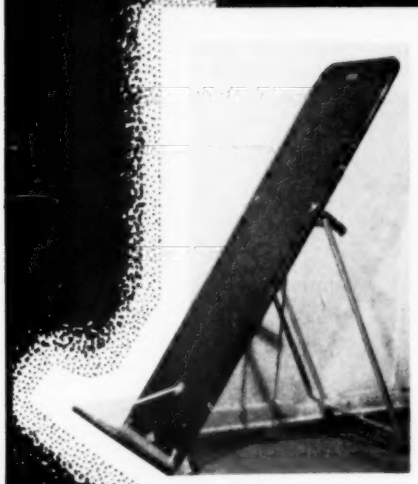
- ☐ UNDER MEDICAL SUPERVISION
- ☐ AT LOW COST TO PATIENT
- ☐ WITHOUT LOSS OF WORK TIME
- ☐ WITH SIMPLICITY AND SAFETY OF OPERATION

ST. LOUIS INSTRUMENT ENGINEERING, INC.
1507 S. Compton Avenue, St. Louis 4, Mo.

Wanted: Two registered physical therapists. Salary $300 per month; vacation period of one month; uniforms laundered; sick leave; lunch; 5 day, 40 hour week. Write Sister M. Flora, Mercy Hospital, 2537 Prairie Ave., Chicago, Illinois. Telephone Victory 2-4700.

Physical Therapist for 150 bed hospital: male or female. Excellent salary. Apply Superintendent, Sheboygan Memorial Hospital, Sheboygan, Wisconsin.

GET THEM ON THEIR FEET



TO AVOID CIRCULATORY COMPLICATIONS

it's new . . . !

it's safe . . . !

it's easy . . . !

THE *"Mary Lee"* LINE
PATIENT ERECTOR & AMBULATOR

CUTS DOWN HOSPITAL OVERHEAD
SPEEDS PATIENT RECOVERY
LIGHT IN WEIGHT, EASY TO MANIPULATE

write

M. L. SPECIALTIES, Co., Inc. Box 93, R.D. 1, Monticello, N.Y.

Members
Standing Committees of the
American Congress of Physical Medicine and Rehabilitation
1953

Advances in Education
Earl C. Elkins, M.D., Chairman.
Harold Dinken, M.D.
Thomas F. Hines, M.D.
Frederic J. Kottke, M.D.
Herman L. Rudolph, M.D.

Awards for Scientific Exhibits
Ben L. Boynton, M.D., Chairman.
Robert C. Darling, M.D.
Donald L. Rose, M.D.
Joseph N. Schaeffer, M.D.
Harry T. Zankel, M.D.

Balneology and Health Resorts
Hans J. Behrend, M.D., Chairman.
William Bierman, M.D.
K. G. Hansson, M.D.
Walter S. McClellan, M.D.
Duane A. Schram, M.D.
Ferdinand F. Schwartz, M.D.
Samuel A. Warshaw, M.D.

Braces, Splints and Prostheses
H. Worley Kendell, M.D., Chairman.
John H. Aldes, M.D.
Robert L. Bennett, M.D.
George G. Deaver, M.D.
Louis B. Newman, M.D.
Odon F. von Werssowetz, M.D.
Jessie Wright, M.D.

Constitution and By-Laws
Walter S. McClellan, M.D., Chairman.
K. G. Hansson, M.D.
Gordon Martin, M.D.

Cooperation with Air Force, Army, Navy, Public Health and Veterans Administration
Alvin B. C. Knudson, M.D., Chairman.
Carrie Chapman, M.D.
Benjamin A. Strickland, Jr., M.D.

Cooperation with Food and Drug Administration
Charles S. Wise, M.D., Chairman.
Ralph E. DeForest, M.D.
Fritz Friedland, M.D.
Joseph L. Hollander, M.D.
Florence I. Mahoney, M.D.
Gordon Martin, M.D.
Sedgwick Mead, M.D.
Fred B. Moor, M.D.
Paul A. Nelson, M.D.

Correlation of Physical Medicine and Psychiatry
Jack Meislin, M.D., Chairman.
Donald A. Covalt, M.D.
Daniel Dancik, M.D.
A. Ray Dawson, M.D.
Everill Fowlks, M.D.
Henry Morelewicz, M.D.

John S. Coulter Memorial Lecture Fund
Walter J. Zeiter, M.D., Chairman.
Ben L. Boynton, M.D.
Walter M. Solomon, M.D.

Ethics
Howard A. Rusk, M.D., Chairman.
Don J. Erickson, M.D.
Keith Keeler, M.D.
Frederic J. Kottke, M.D.
William Northway, M.D.

Finance
H. Worley Kendell, M.D.
Walter M. Solomon, M.D.
Charles S. Wise, M.D.

Foster, Encourage and Coordinate Research Projects
Robert Boyle, M.D., Chairman.
Michael Dacso, M.D.
Karl Harpuder, M.D.
F. A. Hellebrandt, M.D.
William D. Paul, M.D.
Wilbur A. Selle, Ph.D.

Gold Key Awards
William D. Paul, M.D., Chairman.
Alvin B. C. Knudson, M.D.
Gordon Martin, M.D.
Donald L. Rose, M.D.
Howard A. Rusk, M.D.

Legislation
William Bierman, M.D., Chairman.
A. Ray Dawson, M.D.
Harold Dinken, M.D.

Medical Economics
Frances Baker, M.D., Chairman.
Arthur Jones, M.D.
Albert A. Martucci, M.D.

Meeting Place
Walter J. Zeiter, M.D., Chairman.
Miland E. Knapp, M.D.
Paul A. Nelson, M.D.
George M. Piersol, M.D.
James W. Rae, Jr., M.D.

Membership
Max K. Newman, M.D., Chairman.
Thomas P. Anderson, M.D.
Elizabeth Austin, M.D.
Leslie Blau, M.D.
Donald A. Covalt, M.D.
C. DeWitt Dawson, M.D.
S. Malvern Dorinson, M.D.
Fred Fricke, M.D.
Harriet E. Gillette, M.D.
Gustave Gingras, M.D.
Meyer Glick, M.D.
Glenn Gullickson, Jr., M.D.
Dean M. Hayes, M.D.
Thomas F. Hines, M.D.
Morton Hoberman, M.D.
Carl C. Hoffman, M.D.
Frederic House, M.D.
Arthur Jones, M.D.
Herbert Kent, M.D.
Edward M. Krusen, Jr., M.D.
Frank H. Krusen, M.D.
John H. Kuitert, M.D.
Walter J. Lee, M.D.
Florence I. Mahoney, M.D.
Nicholas Mauriello, M.D.
Sedgwick Mead, M.D.
Charles O. Molander, M.D.
Robert Newman, M.D.
Ray Piaskoski, M.D.
Nathan Polmer, M.D.
Jacob Rudd, M.D.
Oscar Selke, Jr., M.D.
Ferdinand Schwartz, M.D.
Euclid Smith, M.D.
Bror S. Troedsson, M.D.
George Twombly, Jr., M.D.
George Wilson, M.D.
Ralph Worden, M.D.

Nominating
Robert L. Bennett, M.D., Chairman.
Earl C. Elkins, M.D.
O. Leonard Huddleston, M.D.
H. Worley Kendell, M.D.
Arthur L. Watkins, M.D.

Prize Lecture
William D. Paul, M.D., Chairman.
Frederic T. Jung, M.D.
Allen Russek, M.D.
Arthur L. Watkins, M.D.

Problems Affecting Physical and Occupational Therapists
William B. Snow, M.D., Chairman.
Herman J. Bearzy, M.D.
Robert L. Bennett, M.D.
Nila Kirkpatrick Covalt, M.D.
Sedgwick Mead, M.D.
Jessie Wright, M.D.

Program
Arthur L. Watkins, M.D., Chairman.
William Schmidt, M.D.
Walter J. Zeiter, M.D.

Public Relations
Frank H. Krusen, M.D., Chairman.
Edward H. Lowman, M.D.
Herman Rudolph, M.D.

Contents—Feb. 1953

Volume XXXIV No. 2

ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION
(Formerly Archives of Physical Medicine)
30 North Michigan Avenue, Chicago 2, Illinois

Original contributions, exchanges and books for review should be forwarded to the Editorial Office. All business matters including advertising should be handled through the Executive Office, 30 N. Michigan Ave., Chicago 2, Illinois. The statements in the manuscripts published in the ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION are made solely on the responsibility of the author. The American Congress of Physical Medicine and Rehabilitation and/or the American Society of Physical Medicine and Rehabilitation does not assume any responsibility for statements contained therein. Manuscripts accepted for publication in the ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION are for exclusive publication and may not be published elsewhere.

OFFICERS

American Congress of Physical Medicine and Rehabilitation

WALTER M. SOLOMON, M.D., Cleveland, President.
WILLIAM B. SNOW, M.D., New York, N. Y., President-Elect.
WILLIAM D. PAUL, M.D., Iowa City, Iowa, First Vice-President.
HOWARD A. RUSK, M.D., New York, N. Y., Second Vice-President.
GORDON M. MARTIN, M.D., Rochester, Minn., Third Vice-President.
A. B. C. KNUDSON, M.D., Washington, D. C., Fourth Vice-President.
DONALD L. ROSE, M.D., Kansas City, Kan., Fifth Vice-President.
FRANCES BAKER, M.D., San Mateo, Calif., Secretary.
FRANK H. KRUSEN, M.D., Rochester, Minn., Treasurer.
WALTER J. ZEITER, M.D., Cleveland, Executive Director.
DOROTHEA C. AUGUSTIN, Chicago, Executive Secretary.

EXECUTIVE COUNCIL

Robert L. Bennett, M.D., Warm Springs, Ga., *Chairman.*
Norman E. Titus, M.D., West Chester, Pa., *Secretary.*
William Bierman, M.D., New York, N. Y.
Earl C. Elkins, M.D., Rochester, Minn.
Kristian G. Hansson, M.D., New York, N. Y.
John Severy Hibben, M.D., Pasadena.
Abraham R. Hollender, M.D., Miami Beach, Fla.
O. Leonard Huddleston, M.D., Santa Monica, Calif.
H. Worley Kendell, M.D., Peoria, Ill.
Miland B. Knapp, M.D., Minneapolis, Minn.
Disraeli Kobak, M.D., Chicago.
Frank H. Krusen, M.D., Rochester, Minn.
Walter J. McClellan, M.D., Saratoga Springs, N. Y.
Fred B. Moor, M.D., Los Angeles.
Nathan H. Polmer, M.D., New Orleans.
William T. Schmidt, M.D., Philadelphia.
Arthur L. Watkins, M.D., Boston, Mass.
Walter M. Solomon, M.D., Cleveland, Ohio, Ex-Officio.

EDITOR EMERITUS

Disraeli Kobak, M.D., Chicago.

Subscription — In the United States, its possessions, and Mexico, $7.00 yearly; Canada, $8.00; elsewhere, $14.00 the year.
Advertising rates on application. All advertising copy subject to acceptance by Publication Committee.
COPYRIGHT: Matter appearing in the ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION is covered by copyright. Permission will be granted on request for reproduction in reputable publications if proper credit is given. Reproduction for commercial purposes will not be permitted.
Published monthly at Chicago, Illinois, by the American Congress of Physical Medicine and Rehabilitation.
Entered as Second Class Matter at the Post Office at Chicago, Illinois.

ORIGINAL ARTICLES

Factors Prognostic for Vocational Rehabilitation Among the Physically Handicapped. Marion S. Lesser, M.A., and Robert C. Darling, M.D. 73
Discussed by Dr. G. D. Wilson.

Assistive Devices in Achieving Self-Sufficiency. Leslie Blau, M.D.; Joseph Phillips, B.S., and Donald L. Rose, M.D. 82

Biologic Reactions to Cavitation, a Consideration for Ultrasonic Therapy. Justus F. Lehmann, M.D., and J. F. Herrick, Ph.D. 86

A Forearm-Flexion Device for the Paralyzed Upper Extremity with Potentially Functional Hand. David Rubin, M.D., Ph.D.; O. Leonard Huddleston, M.D., Ph.D.; Patricia Martin, O.T.R.; Mr. Robert Taylor, and Hyman Jampol, M.S., R.P.T. 99

Rehabilitation in the Clinical Management of the Patient with Tuberculosis. Edward E. Gordon, M.D. 104

•

Editorial 109

•

Medical News 112

•

Book Reviews 115

•

Physical Medicine Abstracts 119

•

EDITOR OF THE MONTH

FREDERIC J. KOTTKE, M.D.

Minneapolis, Minn.

Printed in U.S.A.

PROVED

EFFICIENT, EFFECTIVE HEATING

The tissue heating effectiveness of the carborundum-type infra-red element has been demonstrated in a study in which the following temperature changes were recorded:*

Temperature Rise, Degrees C., After One Minute of Heating

ENERGY**, GM, Cal/Cm²/Min	SKIN	SUBCUT.	MUSCLE (4mm. depth)	MUSCLE (10mm. depth)	MUSCLE (15mm. depth)
2.18	7.35	4.40	3.10	0.80	0.25

**Radiant flux density at skin surface.

For a rich source of infra-red, use a Burdick Zoalite Infra-Red Lamp, with the famous Burdick Carborundum Element.

*Arch. Physical Medicine, 30:691-699 (Nov.) 1949.

Burdick **ZOALITE**

Infra-Red Lamps

Burdick Zoalite Infra-Red Lamps are available in sizes suitable for office, hospital and home (Prescription Model).

THE BURDICK CORPORATION, Milton, Wisconsin

Please send me information on Burdick Zoalite Infra-Red Lamps.

Doctor_____

Address_____

City_____ Zone_____ State_____

FACTORS PROGNOSTIC FOR VOCATIONAL REHABILITATION AMONG THE PHYSICALLY HANDICAPPED *

MARION S. LESSER, M.A.†

and

ROBERT C. DARLING, M.D.‡

NEW YORK

One of the highest goals in the rehabilitation of the physically handicapped is the fitting of the individual into the economic framework of our society. This paper is designed to give some insight into the broad question: What are the factors among the physically disabled that are most prognostic for vocational placement? Information pertinent to this question was obtained in the course of an investigation which followed up 531 former clients of The Institute for the Crippled and Disabled, a rehabilitation center of thirty-five years' standing which has grown with the times to include all services proven valuable toward the rehabilitation of patients with orthopedic and neurological handicaps.

Methods

By use of a formal questionnaire, administered by trained interviewers, data on vocational, social, marital, and physical status were collected for 264 people whose cases had been closed at the Institute in 1940 and 1941, and for 267 people whose cases had been closed in 1948 and 1949. In each case, samples were one hundred per cent of all who had attended the Institute and were closed in that period.

The most obvious difference between the group with ten years' experience after rehabilitation and with only two years' lies in the greater practical experience of the former group. Unfortunately for the sake of simple analysis, there are other differences of major importance. With the advances of physical medicine in the intervening ten years, the more recent sample includes many more individuals with severe handicaps who were attracted to the new opportunities for service. For example, 33 per cent of this group had brain damage and 13 per cent had spinal cord damage, compared with 20 and 1 per cent, respectively, in the earlier group. Using a composite index of severity based on degree and extent of involvement, 24 per cent of the 1948-49 group fell in the "severe" category as compared with only 8 per cent in the earlier group. (See appendix tables 1 and 2 for the comparative diagnoses and severity of the two groups.) Many in the more recent group had as valid immediate goals only objectives of a prevocational or subvocational nature. This is indicated by the fact that only 39 per cent were enrolled in formal vocational training, whereas 73 per cent of the earlier group were so enrolled.

The changing population and emphasis in rehabilitation is a fact of some interest in itself. With these factors properly in mind, the data from this study have been analyzed to dissect the individual factors affecting vocational achievement — the diagnosis, severity of disability, age at onset, the degree

* This work was supported in part by a grant to Columbia University from the Baruch Committee on Physical Medicine and Rehabilitation.

† From The Institute for the Crippled and Disabled.

‡ From the Department of Physical Medicine and Rehabilitation, Columbia University, College of Physicians and Surgeons.

of physical independence, present age, sex, education, and intelligence. In many cases, the relationship will appear to be the obvious; in others, the relative influences will be less obvious. After analysis of these factors it will be possible to assess the influence of ten years' practical experience on vocational achievement.

Results

Vocational Achievement. — For present purposes, the criterion for vocational achievement shall be whether or not the individual was gainfully employed at the time that he was interviewed in the follow-up survey. Of the total sample whose cases were closed in 1940-41, 71 per cent were employed in 1951 when they were interviewed. Of the 1948-49 sample, 41 per cent were employed. These proportions shall be considered as the "norm" for each group. Actually, 10 per cent of the 1948-49 sample, and 6 per cent of the 1940-41 sample were employed in part-time, sheltered, or non-competitive jobs. Since this nevertheless represents achievement in the light of the disabilities of those in these jobs, these have been included as representing vocational achievement. For present purposes, we shall omit women with housewife status, although this, of course, also represents achievement. Twelve per cent of the 1940-41 group, and 7 per cent of the 1948-49 group were housewives.

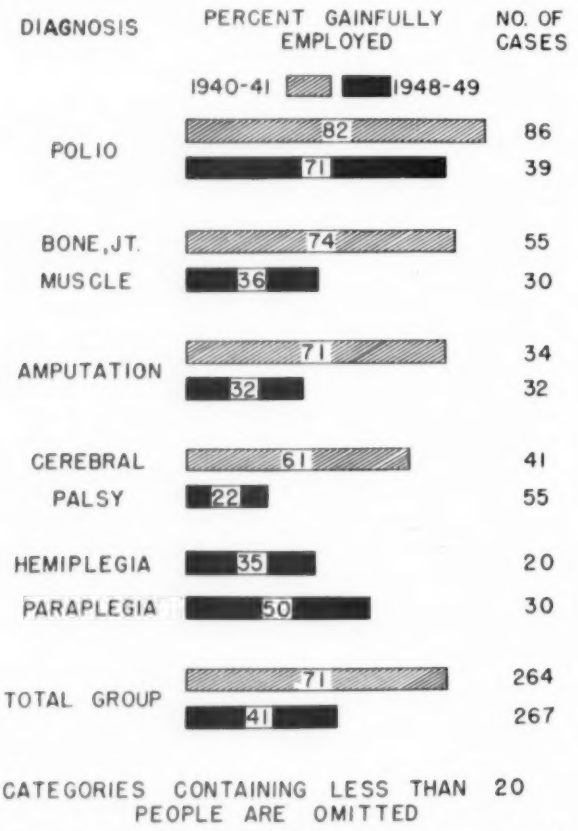


Chart A. — Proportion gainfully employed according to diagnosis — 1940-41 group vs. 1948-49 group.

Diagnosis. — The factors to be analyzed are conveniently divided into the physical elements inherent in the disability and the more general factors operative on any employable group such as age, sex, and education. Among the former elements the factor of diagnosis is the most obvious. Chart A, made up according to very broad categories of disease, will answer some of the questions relating diagnosis to employment success. It should be pointed out that the catgory "Bone, Joint and Muscle" includes a wide range of diagnoses. As a result, conclusions in this area should be guarded.

Several interesting facts are pointed out by the chart. First, it is apparent in both samples that people with poliomyelitis are more likely to be employed than those in any other diagnostic group; and people with cerebral palsy are less likely to be employed than those in any other group. Secondly, the difference in the proportion employed, comparing those with polio and those with cerebral palsy, is much more pronounced in the more recent group than in the earlier group: 22 per cent vs. 71 per cent in the more recent group, and 61 per cent vs. 82 per cent in the earlier group. Thirdly, people with amputations (or with bone, joint and muscle diseases) are at the "norm" in the earlier sample, i. e., about 71 per cent in each group are employed. In the later group, however, people in these two diagnostic categories are below the "norm" of 41 per cent employed. The likely reasons for this apparent anomaly will be discussed later. Fourthly, in the 1948-49 sample, people with paraplegia are more likely to be employed than people with amputations (50 per cent vs. 31 per cent) although those with paraplegia were usually more severely handicapped than those with amputations, both in terms of number of extremities involved and in actual achievement of physical independence. Thus, it is obvious that factors other than diagnosis must be explored.

Age at Onset of Disability. — The age at which an individual becomes disabled has an important influence on his life experiences and on his adaptability. Table 1 shows that there is a marked relationship between age at onset and employment.

	1940-41		1948-49	
Age at Onset	% Employed	Total	% Employed	Total
Birth	63	76	20	65
Up to 29 years	76	179	56	116
30 years or older	*	9	38	86
Total Group	71	264	41	267

*** Only 5 of the 9 people who were over 30 in the 1940-41 sample were employed. The fact that so few in this group became disabled when they were older appears to be another factor which accounts for their greater vocational achievement as compared with the 1948-49 group.**

Table 1. — Proportion gainfully employed according to age at onset of disability — 1940-41 and 1948-49.

People who were disabled at birth are the least likely to be successful in obtaining jobs. This relationship persists even when we take into account the fact that most of those who are in this group were cerebral palsy patients. In the more recent group, those disabled when they were 30 years or older

are more likely to be employed than those disabled at birth, but considerably less likely to be employed than those disabled before they reached 30.

In the light of the importance that age at onset has for employment, we can now readily understand one reason that the amputees in the 1948-49 group are so much less successful vocationally than the amputees in the earlier group. Sixty-nine per cent in the recent group were over 30 at onset, and the bulk of them, 44 per cent, were over 50. Many of the amputations were due to circulatory and degenerative vascular causes. None of the amputees in the earlier group was over 30 at onset, and the amputations were almost all attributable to congenital causes or to trauma. A similar difference in age at onset helps to account for the greater comparative success of the earlier group of people in the broad category of bone, joint and muscle diseases. In the older sample, only 6 per cent were over 30 at onset; while in the more recent sample 27 per cent were over 30 at onset.

With the exception of two people with polio in the 1948-49 group, all of those with polio in both samples were under 30 at onset. Almost all of these patients were disabled between the first and fourteenth years. (See appendix table 3 for age at onset of each diagnostic category.)

Severity of Disability. — If other factors are equal, it might be expected that those with more severe disabilities would have greater difficulty in vocational achievement. An arbitrary index combining the extent and severity of disability will enable us to ascertain whether severity of disability has a greater influence on employment than the nature of the disease. Chart B summarizes the data.

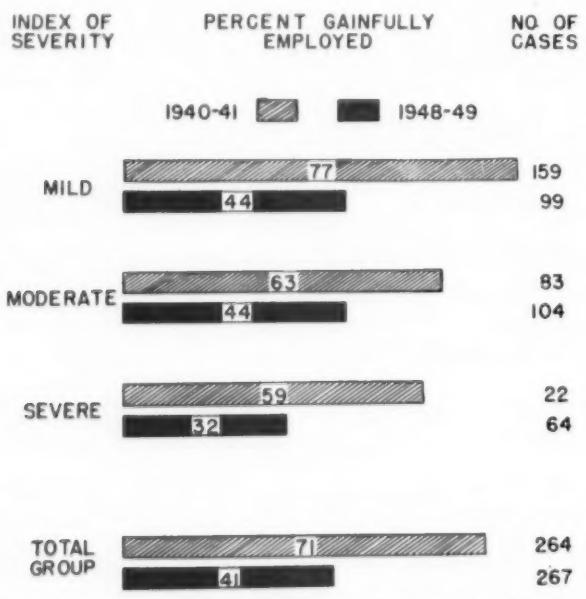


Chart B. — Proportion gainfully employed according to severity of handicap — 1940 group vs. 1948 group.

There is a difference, attributable to severity of the disability, in the proportion employed, but it is not as striking as might be expected. In the more recent sample, people with moderate handicaps are just as likely to be employed as people with mild handicaps. Forty-four per cent in each group

are employed, as compared with 32 per cent who are employed among those with severe handicaps. In the earlier sample, the difference between the 59 per cent employed who have severe disabilities and 63 per cent who have moderate disabilities is not significant. It is worthy of note that in both samples there is a higher relationship between the diagnosis and employment than between severity and employment. Thus, for example, among the 1940-41 group, 77 per cent of the people with mild involvements are employed, but 82 per cent of all those with poliomyelitis, regardless of severity, are employed. Among the 1948-49 group, 32 per cent of all those with severe handicaps are employed, but this is more than the 22 per cent of all cerebral palsied who are employed.

Capacity for Physical Performance. — Functional performance has been properly emphasized as a more dynamic means of evaluation than any index of paralysis. An index of four ambulation and travel abilities was formed in order to separate people in terms of degree of mobility. The index takes into account the individual's ability to climb stairs with or without using a handrail, to cross the street before the light changes to red, to get up from the floor independently, and to use public transportation (table 2).

Independence of Mobility*	1940-41		1948-49	
	% Employed	Total	% Employed	Total
Completely independent	79	142	51	105
Partially dependent	67	109	42	102
Moderately or severely dependent	15	13	23	60
All not independent	61	122	35	162
Total Group	71	264	41	267

* People were considered completely independent in ambulation if they were able to climb stairs without using the handrail, to get up from the floor, to cross the street before the light changes to red, and to use a bus or subway independently. They were considered partially dependent if they were unable to do any one of these activities independently, and moderately or severely dependent if they were unable to do two or more of the ambulatory activities.

Table 2. — Proportion gainfully employed according to ambulatory abilities.

As expected, the individual's ability to get around independently is more highly related to his employment than are the facts of which parts are involved and how severely. It indicates that often people who have been able to compensate for severe disabilities are able to secure employment.

An index of manual abilities includes ability to open and close buttons, cut meat, bathe, and dress one's self independently. These may be considered as basic self-care abilities (table 3).

In the more recent sample there are enough cases to indicate the large difference in the proportion employed between those who are completely independent in these self-care activities, 46 per cent employed, and those who are markedly dependent, 17 per cent employed.

Factors Not Related to Disability. — Thus far, we have considered the rela-

Independence in Self-Care*	1940-41 % Employed	1940-41 Total	1948-49 % Employed	1948-49 Total
Completely independent	73	241	46	210
Partially dependent	62	16	41	22
Moderately or severely dependent	**	7	17	35
All not independent	52	23	26	57
Total Group	71	264	41	267

* Those people were considered completely independent who were able to dress themselves, bathe, open and close buttons, and cut meat independently. The partially dependent were those who were able to do any three of these four activities independently. Those who could do two or fewer of the four were considered moderately or severely dependent.

** Since only 7 people in the 40-41 group are very dependent, we can not trust the statistics but should note that only 2 of the 7 were employed.

Table 3. — Proportion gainfully employed according to self-care abilities.

tionship between employment and a number of physical factors that are specific to the physically handicapped. Let us now consider factors which might influence employment in a nonhandicapped group. In the normal population, age, sex, intelligence and education all play a role in determining the level of an individual's employment.

Sex. — In both samples, a considerably higher proportion of the men are gainfully employed as compared with the women. However, when proper correction is made for women seeking performance only as housewives, there is no difference between the sexes in the amount of occupational achievement.

Age at Time of Follow-Up. — Age appears to play the same role in employment among the handicapped as it does in the normal population. In our data, only the 1948-49 group has sufficient age spread to be analyzed in this regard. Here, between 25 and 59 years, age appears to have no influence on employment. However, people who are younger than 25, and older than 60, are markedly less often employed than those in the middle age groups. Thus it would appear that among the handicapped, as in the normal population, there is more unemployment among people who are at the beginning, and toward the end, of their working lives. The only probable difference is that persons who are handicapped before they have reached working age may take longer to get started on a vocation.

Education. — In the community at large, the level of formal education achieved is generally related to the level of employment reached. Among the two groups here being discussed, formal education not only has a relationship to the status of the job, but also to the fact of employment *per se* (table 4).

People with only grade school education have a less than average chance of being employed; while those who have graduated from high school or attended college have a better than average chance of being employed. This confirms the general principle that the individual with limited physical abilities is particularly in need of extra skills and knowledge that come with education.

Incidentally, the paraplegics in the 1948-49 sample have a higher educational achievement than any other group, and this is at least one of the factors which has helped them to achieve greater vocational success than many others who were less severely disabled, but also less well educated.

Intelligence. — In this population, as in the normal, IQ as measured by standard intelligence tests, is highly related to education and, therefore, to vocational achievement. However, even in groups of similar education, chances for employment increase as the intelligence quotient goes up (table 5).

Formal Education	1940-41 % Employed	1940-41 Total	1948-49 % Employed	1948-49 Total
Grade school or less	63	101	33	86
Some high school	74	99	45	66
High school graduate or more	80	64	54	69
Total Group	71	264	41	267

Table 4. — Proportion gainfully employed according to formal education.

I.Q.	1940-41 % Employed	1940-41 Total	1948-49 % Employed	1948-49 Total
Mental defective or borderline	63	46	14	28
Dull normal	73	41	21	19
Normal	73	84	45	47
Above normal	76	71	69	42
Total Group	71	264	41	267

Table 5. — Proportion gainfully employed according to intelligence quotient as measured by Stanford-Binet (1940-41 group) and Wechsler-Bellevue (1948-49 group).

Experience in the Practical World. — In all of the relationships shown, one factor appears to have a consistent influence on employment, and that is time "out in the world." The comparison between the 1940-41 group and the 1948-49 group points out that time and experience help even the severely disabled individual to compensate for his disabilities, and greatly enhance his employment possibilities. Even those with the worst prognosis for employment, the cerebral palsy patients, tended to "catch up" with those with better prognoses, so much so, that those in the earlier sample were more likely to be employed than any diagnostic group in the more recent sample, with the exception of those with poliomyelitis.

Regardless of diagnosis, the severe disabilities tended to become lesser vocational handicaps, with time. Thus, in the earlier group, 59 per cent and 63 per cent of those with severe and moderate involvements, respectively, are employed, compared with only 44 per cent of those with mild involvements in the recent group.

It is a hopeful fact that severely disabled persons with a bleak vocational prognosis do acquire eventually the experience which enables them to achieve economic and social independence.

Summary and Conclusions

1. We have presented the relationship between a number of factors and employment among two groups of physically handicapped people. Certain factors are consistently more predictive of vocational achievement than others, even though the level of employment and the characteristics of the two groups are quite different.

2. The following factors help to compensate for disability in the achievement of employment:

a. Onset of disability before 30, but after birth.
b. Ability to achieve physical independence.
c. Average or above average intelligence.
d. At least some high school education.

Absence of these compensating factors decreases the chance for employment even among people with relatively minor disabilities. Regardless of other factors, people who have had poliomyelitis have the best prognosis for employment, and people who have cerebral palsy have the worst prognosis.

3. In spite of the differences between the group ten years after rehabilitation and the more recent group, it is clear that the ten year period of practical experience made for greater vocational success.

APPENDIX TABLE 1. — *Diagnosis in the 1940-41 and 1948-49 Samples.*

Diagnosis	1940-41 Sample %	1948-49 Sample %
Congenital brain damage	16	21
Hemiplegia, hemiparesis	2	7
Other noncongenital brain damage	2	6
Paraplegia	*	11
Other spinal cord damage	*	2
Poliomyelitis	33	15
Other lower motor neuron diseases	3	4
Bone, joint and muscle diseases	21	11
Arthritis	2	4
Amputations	13	12
Cardiac disorder	7	1
Miscellaneous, unknown	1	6
Total cases	264	267

* Less than .05 of 1%.

APPENDIX TABLE 2. — *Severity of Disability in the 1940-41 and 1948-49 Samples.*

Index of Severity	1940-41 Sample %	1948-49 Sample %
Mild	60	37
Moderate	32	39
Severe	8	24
Total cases	264	267

* The definition of severity takes into account both the number of extremities involved and the extent of the neurological or paralytic disorder. The category defined as "mild" includes people with one or no extremities involved, or two extremities mildly affected. The "moderate" category includes people with two extremities moderately or severely affected, and those with three or four extremities mildly affected. The category defined as "severe" includes people with three or four extremities either moderately or severely affected.

APPENDIX TABLE 3. — *Age of Onset of Disability According to Diagnosis, 1940-41 and 1948-49 Samples.*

Diagnosis	1940-41 Sample: Birth %	Under 30 %	Over 30 %	Total #	Total %	1948-49 Sample: Birth %	Under 30 %	Over 30 %	Total #	Total %
Cerebral palsy	100	....	....	41	100	100	....	....	55	100
Hemiplegia	*	*	*	6	.....	.....	30	70	20	100
Paraplegia	*	*	*	1	.....	3	50	47	30	100
Poliomyelitis	....	100	....	86	100	....	94	6	39	100
Bone, joint and muscle diseases	29	65	6	55	100	27	46	27	30	100
Amputations	32	68	....	34	100	3	27	70	32	100

* Diagnostic categories with fewer than 20 people are not presented in the table.

Discussion

Dr. George Darwin Wilson (Asheville, N. C.): The authors of this important paper are to be congratulated for presenting the follow-up study of handicapped people so badly needed in the field of rehabilitation. We all want to know what happens to our patients five or ten years later. We all want to know how are they employed, whether they are progressing, standing still or regressing. These questions are yardsticks of the value of our work.

The handicapped cases were closer at hand for restudy by the authors, whereas previous studies made both from private and federal rehabilitation centers used mailed questionnaires which are not as satisfactory as personal check-ups. The authors were aware of the many pitfalls in the follow-up study of physically handicapped. In the 35 year history of this Institute, Physical Medicine and Rehabilitation has advanced so rapidly that more severely handicapped people are treated today in comparison to even ten years ago.

The criterion for evaluation of vocational achievement was gainful employment, omitting the housewife. They showed 71 per cent gainfully employed in the 10 year closed case group and 41 per cent of the one year group studied. Rehabilitation of a housewife may be considered gainful when the family budget changes from the red to black side of the ledger. For example, this discussor reported in 1950 the actual cost of the "Third Phase" of medical care in a severe case of poliomyelitis in a young housewife with two children restored to operating her own home in 24 weeks; this comprised one-third of the cost of a maid and one-fourth the cost of a practical nurse paid in a previous eight week period, excluding cost of a visiting physical therapist who had worked on the case prior to the "Third Phase." This is indirectly gainful employment of a housewife that changed the financial status of a family unit, freeing a part of the husband's pay check to pay for a new home and leaving some for taxes.

One of the most interesting facts brought out by the authors in their analysis of Chart A revealed that improvement of rehabilitation of the amputee still presents a challenge. Their study showed paraplegics are more likely employed than is the amputee, in the ratio of 51 per cent to 31 per cent; yet paraplegia is considered the more severe handicap. This truth is obvious when one counts the number of street beggars without arms or legs compared to number of paraplegics begging. This fact is a direct challenge to our field, for two reasons. One is the fact that amputees can be helped to be gainfully employed, second, all taxpayers now pay doubly to assist the handicapped through state-federal agencies and community chest agencies.

We all recall the problem of grading physical performance and the long lists of physical achievements to be checked in order to grade a physically handicapped individual as being dependent or independent. Recalling World War II, some achievement charts required 99 different physical performances to pass; today it is good to learn that the authors cut down the number of physical achievements to four major accomplishments necessary for employment. Physical independence was graded by ability to climb stairs, cross the street with a traffic light, get up from a floor and to use public transportation. If we all use these four goals then we will have better success in rehabilitation, especially of a single or double amputee. We shall see fewer artificial limbs in closets when we can train amputees to walk outside a sheltered workshop or on the smooth floor of a hospital.

This study shows one outstanding fact that poliomyelitis cases have the best chance of employment; cerebral palsy cases the least chance. The ten year paraplegics had the highest educational level. All these figures and data will be more valuable as more centers follow up their cases years later. This study will be of interest today as related to rehabilitation of tuberculous patients now under study in several federal and state institutions. This work of the authors will certainly be referred to more as time elapses in the field of rehabilitation and we must look now to long term evaluation of physical achievement as applied to the geriatric patients.

I would like to ask, what was the approximate cost of the author's survey?

ASSISTIVE DEVICES IN ACHIEVING SELF-SUFFICIENCY *

Introduction of a New Device for Quadriplegics

LESLIE BLAU, M.D.†
WADSWORTH, KANSAS
JOSEPH PHILLIPS, B.S.†
WADSWORTH, KANSAS
and
DONALD L. ROSE, M.D.‡
KANSAS CITY, KANSAS

When a patient becomes ill the aim of therapy is to provide a cure. Occasionally, however, therapeutic efforts may fail entirely or the nature of the disease may be such that a cure, as such, cannot occur and the patient must endure from thereon the life of an invalid. In such instances active treatment is usually terminated when the condition of the patient becomes stabilized because further improvement in the clinical status is not anticipated. The true meaning of rehabilitation becomes a reality when we are still able to offer therapeutic means to such a patient. One of the most important contributions of physical medicine and rehabilitation has been the development of assistive devices which aid in the attainment of self-sufficiency. These devices are usually adapted for the use of an individual patient, yet they may be applied to those having similar physical deficiencies.

Assistive devices for paraplegic and quadriplegic patients came into use during the World War II period as a result of serious effort to enable these individuals to become self-sufficient again. In the case of the quadriplegic patient, even a minimal residual strength of a muscle group can be made useful for function by the utilization of a properly designed assistive device. Most of the devices have been improvised for essential activities of daily living such as eating and toilet activities.[1,2,3,4,5,6] Some of the devices have been so fabricated as to be adapted also for other uses such as writing, typing, smoking[4,7] or simply for grasping as used in miscellaneous hand activities.[8] A triceps substitute brace was improvised as a holder for eating devices. It could be used also for resistive exercises and as a splint.[9] Devices were also designed for standing[10] and vocational usefulness;[11] others have been devel-

---

* Read at the Thirtieth Annual Session of the American Congress of Physical Medicine, New York, N. Y., Aug. 29, 1952.

† From the Physical Medicine Rehabilitation Service, Veterans Administration Center, Wadsworth, Kansas. Reviewed in the Veterans Administration and published with approval of the Chief Medical Director who assumes no responsibility for the opinions expressed or the conclusions drawn by the authors.

‡ From the University of Kansas School of Medicine.

1. Shear, H. R., and Comarr, E.: Eating Devices for the Paraplegic Patient, Occup. Therapy **28**:154, 1949.
2. McHugh, W.: Development of Devices for Self-Feeding of the Quadriplegic, Journal of Physical and Mental Rehabilitation **4**:14, 1951.
3. Clarke, M. D.; McGovern, J. P., and Lee, W. J.: "Self-Help Aids" in the Rehabilitation of the Quadriplegic Patient, Occup. Therapy **27**:167, 1948.
4. Richter, R. J.: Occupational Therapy for the Quadriplegic Patient, Am. J. Occup. Therapy **4**:1, 1950.
5. Gingras, G., and Hardy, G.: Occupational Therapy and Quadriplegia, Occup. Therapy **27**:159, 1948.
6. Bennett, R. L., and Stephens, H. R.: Care of Severely Paralyzed Upper Extremities, J. A. M. A. **149**:105, 1952.
7. Neuman, L. B.: Special Hand Splints for the Disabled, Arch. Phys. Med. **28**:770, 1947.
8. Kabat, H., and Rosenberg, D.: Device for Grasp and Release by the Completely Paralyzed Hand, Arch. Phys. Med. **32**:462, 1951.
9. Shear, H. R., and Comarr, E.: A Triceps Substitute Brace for Quadriplegics, Arch. Phys. Med. **31**:518, 1950.
10. Neuman, L. B., and Jameson, E. L.: Assistive Devices for the Disabled, Occupational Therapy and Rehabilitation **30**:8, 1951.
11. Friedland, F.; Owens, A. P., and Cabo, J. G.: Contribution to the Rehabilitation of Quadriplegic Patients, Arch. Phys. Med. **30**:450, 1949.

oped for miscellaneous purposes such as easier exercising,[12] driving,[13] and recreation.[5]

One of the main problems of the quadriplegic patient, who suffers also from paralysis of the abdominal and back extensor muscles, is to change from the sitting or recumbent position to the erect position without requiring assistance from others. In a previous paper[14] a device was described by means of which a patient was able to stand from a sitting position. The purpose of this paper is to describe a device which enables a severely paralyzed individual to go from a recumbent to a sitting position. The need for such a device is obvious as attested by the number of electric or hydraulic lifters and bed frames which are commercially available. These commercial devices are frequently expensive (several hundred dollars) or the quadriplegic needs assistance for their operation. The apparatus to be described may be constructed locally, is inexpensive, and does not require assistance for the patient.

The device was adapted for a 34-year-old patient suffering from poliomyelitis of the severely paralytic spinal type of 14 months' duration. He was considered a quadriplegic, since all muscle groups required to accomplish purposeful activities were weaker than "fair" and therefore not capable of moving the joint or raising the corresponding segment against gravity. The only exceptions to this were "normal minus" elbow flexors on the left and "good minus" on the right. He could make a fist bilaterally, but his grip was zero as measured with a standard grip dynamometer. His abdominals and erector spinae were "trace." Long leg braces were necessary for ambulation and a canvas corset with posterior and lateral metal stays provided support of his trunk in the sitting or erect position.

Having such weak musculature, the patient had to rely on the force of gravity and the weight of his extremities and trunk for movement. He learned to balance these forces with extraordinary skill in his fight for self-sufficiency. He used his powerless hands also with amazing skill. Not having power to grip or hold, which are the most important fundamental movements for hand activities, he used his hands for pushing, pulling and hooking.

To achieve independence for such a patient many of the devices mentioned before had to be adapted. However, it was necessary to devise the one described herein to enable him to sit from a recumbent position, without human assistance (figure 1).

The device consists of four major parts as follows: 1. Overhead pipe frame. 2. Pulleys. 3. Counterbalance and counterweight. 4. Notched bar.

The overhead frame is fabricated of standard one inch pipe and fittings as follows:

One horizontal pipe, seven feet long, threaded at both ends.
Two vertical pipes, four feet long, threaded at one end.
One horizontal extension pipe, nine inches long, threaded at one end.
One standard pipe T fitting.
One standard pipe elbow fitting.
Four ¾ in. U-type pipe clamps.
One stud, ¾ in. x 1½ in., cold rolled steel, threaded at one end.

One vertical pipe is jointed to the horizontal pipe at the headboard with the elbow fitting and the other at the footboard with the T-fitting. The vertical pipes are clamped to the head and foot of the bedstead with the U-type clamps. The nine inch horizontal extension pipe is threaded

12. Shear, H. R., and Comarr, E.: An Exercise Glove for Quadriplegics, Arch. Phys. Med. **30**:453, 1949.
13. Staub, P. L., and Whiting, H. S.: Driving Devices for the Quadriplegic Patient, Occup. Therapy **27**:172, 1948.
14. Blau, L.; Phillips, J., and Rose, D. L.: A Device to Facilitate Standing From a Sitting Position: For Patients with Severe Residuals of Poliomyelitis, Arch. Phys. Med. **33**:159, 1952.

into the open end of the T-fitting, allowing for attachment of the counterweight pulley.

A set of four 3 inch standard traction pulleys is attached to the horizontal pipe with clamps. Two of these pulleys are directed upward and two downward as follows:

One pulley upward and one downward — two feet in from the headboard vertical pipe.

One pulley extending upward on the horizontal pipe extension, 9 in. outboard from the vertical pipe at the foot of the bed.

One pulley extending downward on the horizontal pipe, 6 in. from the footboard vertical pipe toward the center.

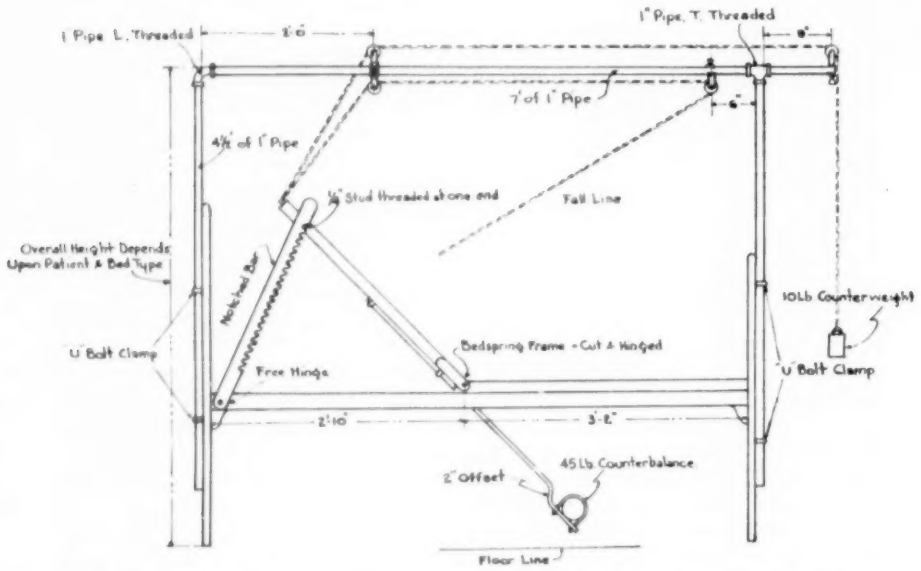


Fig. 1. — The device, showing a schematic side view as it was assembled on an ordinary hospital bed.

A piece of ¾-inch sash cord is secured to the center of the bedspring frame at the head end and threaded over the two upright pulleys to the counterweight. Another piece of ⅜-inch sash cord is secured at the same part of the bedspring frame and is threaded over the pulleys, extending downward on the horizontal pipe to form a fall line, which the patient grasps.

The forty-five pound cylindrical counterbalance is attached to a piece of bar steel, ½ x 2 x 36 inches. The bar has a two inch offset, eight inches from the point of attachment of the weight. This allows clearance for the weight bulk when the bed springs are in a horizontal position. This assembly is bolted at the center of the hinged section of the bedspring frame, with a free overhang of eighteen inches at the weighted end. The ten-pound cylindrical counterweight is drilled and tapped for a ¼-inch metal eyebolt. This allows for attachment of the sash cord. The counterweight keeps the lines taut and assists in the elevation of the hinged section of the bed.

An aluminum bar, ½ x 2 x 26 inches, is notched every two inches so that the ¼-inch stud of the bedspring frame will slide freely over the indentions on any upward motion of the hinged section but will prevent any downward motion of more than two inches. This enables the patient to stop and rest

at any point of progression from recumbent to sitting position, as the stud of the bedspring frame drops into the corresponding slot in the aluminum bar and holds the degree of elevation. The aluminum bar is attached to the main bed frame on a free hinge. This allows for moving the bar to and fro in the upward and downward motion of the hinged section of the bed.

Summary

1. The device is so fabricated that a patient does not need more pulling strength than one normally possesses in the little finger (about five pounds). The traction force can be transmitted by any of the muscle groups of the upper extremity. For instance, our patient had zero grip and no pulling force in fingers but could wind the cord around his hand and pull with the biceps brachii.

2. It is so simple to fabricate that any blacksmith or mechanic could reproduce it and mount it on an ordinary hospital bed.

3. It is so cheap that a patient with the most meager means could have access to it. Total cost of material is about $15 and fabrication requires six hours.

4. Its application could easily enhance the independence of numerous invalids who heretofore could not get out of bed without human assistance.

Acknowledgment. — The authors are grateful to Mr. Andrew Cates, Chief Orthotist at Wadsworth Veterans Administration Center for the fabrication of the device. We are also thankful to Mrs. Virginia Cummins for the preparation of the manuscript.

Copies of many back issues of

THE ARCHIVES

are still available.

For issues desired and prices, write to

American Congress of Physical Medicine and Rehabilitation

30 N. Michigan Ave., Chicago 2, Ill.

BIOLOGIC REACTIONS TO CAVITATION, A CONSIDERATION FOR ULTRASONIC THERAPY *

JUSTUS F. LEHMANN, M.D.

Fellow in Biophysics

and

J. F. HERRICK, Ph.D.

Section of Biophysics and Biophysical Research

Mayo Foundation, University of Minnesota and Mayo Clinic

ROCHESTER, MINN.

Introduction

The formation of small cavities accompanied by a sizzling noise may be observed when a medium is exposed to ultrasonic energy of high intensities (vide monographs of Bergmann,[1] Hiedemann,[2] Lehmann [3]). The cavities are formed during the phase of low pressure in the ultrasonic waves. As a result of the rarefaction the liquid is disrupted. It is assumed that tiny flaws or gas bubbles in the medium promote the occurrence of the cavities, for the cohesive force of the liquid is of the order of 1,000 kg. per sq. cm. and the amplitude of pressure in the ultrasonic waves is only about 5 kg. per sq. cm. at an intensity of 10 watts per sq. cm. (Blake,[4] Lange,[5] Keller[6]). This information of empty spaces in the ultrasonic waves is called cavitation. There are several types of cavitation. Gas bubbles are formed if the medium, as for instance the biologic tissue, contains a dissolved gas, in which case the gaseous type of cavitation (pseudocavitation) occurs. When these cavities collapse during the phase of compression, pressures of the order of 1,000 atmospheres are created (Rayleigh [7]). When the gas bubbles grow to such a size that they oscillate in resonance with the ultrasonic frequency, great alternating accelerations are created (Pfriem,[8] Smith,[9] Minnaert,[10] Meyer and Tamm,[11] Trilling [12]).

As a result of these great mechanical forces bacteria are destroyed (Grabar and Rouyer,[13] Grabar and Prudhomme [14-15-16]). Red blood corpuscles are

* The major portion of this investigation was carried on at the 1. Med. Univ. Clinic, Frankfurt/Main, Germany.

1. Bergmann, Ludwig: Der Ultraschall und Seine Anwendung in Wissenschaft und Technik. Ed. 5, Stuttgart, S. Hirzel Verlag, 1949, pp. 748.
2. Hiedemann, F.: Grundlagen und Ergebnisse der Ultraschallforschung. Berlin, Walter de Gruyter & Co., 1939.
3. Lehmann, J. F.: Die Therapie mit Ultraschall und ihre Grundlagen. Ergebn. d. phys.-diätet. Therap. **4**:196, 1951.
4. Blake, F. G.: The Tensile Strength of Liquids. June 11, 1949. Office of Naval Research. Contract N.50R.1.76, Project Order X, NR.014.903. Acoustics Research Lab., Dept. Eng. Sci. and App. Physics. Harvard University, Cambridge, Mass.
5. Lange, T.: Schwingungskavitation in Flüssigkeiten. Akustische Beihefte, Heft 2A.B. 75 — A.B. 82, 1952.
6. Keller, H.: Ein Beitrag zum Wesen der Kavitation. In Matthes, K., and Rech, W.: Der Ultraschall in der Medizin. Zürich, S. Hirzel Verlag, **1**:75, 1949.
7. Rayleigh, J. W. S.: The Theory of Sound. Ed. 2, London, Macmillan & Co., 1894-1896, 2 vols.
8. Pfriem, H.: Akustische Ztschr. **5**:202, 1940.
9. Smith, F. D.: On the Destructive Mechanical Effects of the Gas-bubbles Liberated by the Passage of Intense Sound Through a Liquid. Philosophical Magazine & J. Sc. **19**:1147 (June) 1935.
10. Minnaert, M.: On Musical Air-bubbles and the Sounds of Running Water. Philosophical Magazine & J. Sc. s.7, **16**:235 (Aug.) 1933.
11. Meyer, Erwin, and Tamm, Konrad: Eigenschwingung und Dämpfung von Gasblasen in Flüssigkeiten. Akustische Ztschr. **4**:145, 1939.
12. Trilling, Leon: The Collapse and Rebound of a Gas Bubble, J. Applied Physics. **23**:14 (Jan.) 1952.
13. Grabar, P., and Rouyer, M.: La désintégration des microbes par les ultrasons. Ann. Inst. Pasteur. **71**:154 (Mar.-Apr.) 1945.
14. Grabar, Pierre, and Prudhomme, Robert: Sur le mécanisme de certaines actions chimiques des ultrasons sur des corps en solution aqueuse. Compt. rend. Acad. d. sc. **226**:1821 (May) 1948.
15. Grabar, P., and Prudhomme, R. O.: Action des ultrasons sur les macromolécules, J. de chim. phys. **44**:115, 1947.
16. Grabar, P., and Prudhomme, R. O.: Die mechanischen und chemischen Wirkungen der Ultraschallwellen. In Matthes, K., and Rech, W.: Der Ultraschall in der Medizin. Zürich, S. Hirzel Verlag 1949, vol. 1, pp. 114-119.

converted into colloidal particles (Lehmann[17,18]). Besides these mechanical effects, cavitation is responsible for most of the chemical reactions created by ultrasonic energy. Luminescence occurs and water molecules are decomposed into the chemically effective radicals O and OH (Grabar and Prudhomme[14-16]). Finally the temperature of the bubbles may be raised considerably during the collapse (Marinesco[19]).

These effects of cavitation, especially the mechanical effects, are very destructive in the test tube, according to the investigations of Grabar and Rouyer.[13] Therefore the question arose whether cavitation is encountered under therapeutic conditions. In order to answer this question it is necessary to consider the physical conditions which influence the occurrence of cavitation. The amplitude of pressure in the ultrasonic waves must exceed a certain threshold in order to disrupt the liquid (Bergmann,[1] Blake[20]). According to Pohlman,[21] this threshold increases with the increase of the ultrasonic frequency, because on the one hand a certain period of time is necessary for the formation of the small gas bubbles and on the other hand the available duration of the phase of low pressure becomes shorter as frequencies of the ultrasonic waves become higher. According to Möller and Schoch,[22] a certain period of time is also required for the collapse of the cavities. It is:

$$t = 0.915 \cdot R_0 \sqrt{\frac{\rho}{P_0}} \quad \left[\text{sec.}\right]$$

in which t is the time, R_0 the radius of the bubble in the beginning, ρ the density and P_0 the hydrostatic pressure of the liquid. According to this equation, the magnitude of t is 10^{-6} to 10^{-7} second. Furthermore, Briggs, Johnson and Mason[23] found experimentally that cavitation was observed at higher ultrasonic intensities when the duration of the ultrasonic pulse was decreased. Muller and Willard[24] studied the influence of the ultrasonic frequency on the occurrence of cavitation. They were unable to produce any cavitation at the very high frequency of 5 megacycles per second, even if they employed an intensity of 5,000 watts per sq. cm. Sörensen[25] demonstrated, also, that the degassing effect of ultrasonic energy is dependent on the frequency. If a lower frequency is used, less ultrasonic energy is necessary to expel 1 cc. of gas from water. Briggs, Johnson and Mason[23] showed that the production of cavitation was more difficult the greater the viscosity of the solution. According to Sollner,[26] cavitation occurs more easily at interfaces between mediums of different acoustic impedance than at other sites. Finally the pressure in the medium is decisive for the occurrence of

17. Lehmann, Justus: Beitrag zur Ultraschällhamolyse. Strahlentherapie. **79**:533, 1949.
18. Lehmann, Justus: Die Wirkung des Ultraschalls auf die Formelemente des Blutes. In Wocher, Karlheinz: Der Ultraschall in der Medizin. Zürich, S. Hirzel Verlag, 1950, vol. 2, pp. 18-21.
19. Marinesco, Néda: Déflagration des substances explosives par les ultrasons. Compt. rend. Acad. d. sc. **201**:1187, 1935.
20. Blake, F. G.: The Onset of Cavitation in Liquids. I. Contract N.50R. 1-76, Project Order X, N.R.-014.903. Technical Memorandum 12. Acoustics Research Lab., Dept. Eng. Sci. and App. Physics. Harvard University, Cambridge, Mass.
21. Pohlman, R.: Über die mechanische und chemische Festigkeit biologischer Substanzen als Beitrag zum ultraschalltherapeutischen Wirkungsmechanismus. In Matthes, K., and Rech, W.: Der Ultraschall in der Medizin. Zürich, S. Hirzel Verlag, 1949, vol. 1, pp. 131-135.
22. Möller, H. G., and Schoch, A.: Versuche über die Entstehung der Druckstösse bei der Kavitation. Akustische Ztschr. **6**:165, 1941.
23. Briggs, H. B.; Johnson, J. B., and Mason, W. P.: Properties of Liquids at High Sound Pressure, J. Acoust. Soc. America **19**:664 (July) 1947.
24. Muller, J. F., and Willard, G. W.: Effects of High Intensity Ultrasonic Radiation, J. Acoust. Soc. America **20**:589 (July) 1948.
25. Sörensen, Christian: Absorptions, Geschwindigkeits- und Entgasungsmessungen im Ultraschallgebiet, Ann. Phys. **26**:121 (May) 1936.
26. Sollner, Karl: Ultrasonic Waves in Colloid Chemistry, J. Phys. Chem. **42**:1071 (Nov) 1938.

cavitation (Briggs, Johnson and Mason,[22] Blake[29]). The higher the ultrasonic intensity, the greater is the pressure necessary to prevent cavitation.

In agreement with the investigations described in previous paragraphs, one of us (Lehmann[17]) was able to demonstrate that a biologic reaction, as for instance hemolysis, was dependent also on the ultrasonic frequency. According to Dognon and Biancani,[27 28] Dognon and Simonot,[29] E. N. and E. B. Harvey and Loomis,[30-31-32-33] Johnson,[34] Schmitt and Uhlemeyer,[35] hemolysis was observed simultaneously with the degassing effect of ultrasonic energy. The higher the ultrasonic frequency, the later the hemolysis and gaseous cavitation (pseudocavitation) were encountered. Furthermore, the greater the viscosity of the suspension fluid and the greater the volume percentage of the red blood corpuscles, the later the reactions were observed. Therefore it was assumed that under a set of circumstances such as used in therapy, cavitation does not occur. The reaction was repressed at the high ultrasonic frequency by the great viscosity of the liquids of the body and by the great volume-percentage of cells in the organs. In contrast to this, Pohlman[21] and Böni[36-37] surmised that cavitation not only occurred in the tissues but also played a major role in creating the therapeutic effects.

Until now it has not been possible to determine experimentally whether cavitation can be produced under therapeutic conditions in the living organism. That could not be done because neither a physical nor a biologic method of sufficient sensitivity existed to test the occurrence of cavitation in a living animal. Therefore it was necessary first of all to find a biologic reaction due to cavitation. Furthermore, the threshold of ultrasonic intensity had to be investigated. This was necessary in the interest of safety for the use of ultrasound in therapy, since the mechanical and presumably the thermal and most of the chemical effects of cavitation are very destructive (Lehmann[3]). In particular, the question was raised whether the different types of ultrasonic generators can be employed safely with regard to the occurrence of cavitation. Three types are available from manufacturing companies. They have half-wave rectification, full-wave rectification, and full-wave rectification with the fluctuations practically eliminated. These machines produce ultrasonic waves of different contour. The first two types have high peak values, which exceed by several times the effective value measured with the power meter.

Methods

The following types of ultrasonic generators were used: The Ultrasonator of the Ultrakust Company, which has a frequency of 1,000 kilocycles per second (kcps.); and the Siemens Sonostat, with a frequency of 800 kcps. Both generators have a radiating surface of 10 sq. cm. The third generator was produced by the Atlas Corporation. It has a magnetostrictive transducer

27. Dognon, A., and Biancani, H.: Les ultra-sons et leurs actions biologiques, Radiologica, **3**:40, 1938.
28. Dognon, A., and Biancani, E. H.: La lumière et le son, Ann. Inst. d'actinol. **12**:61 (Feb.) 1938.
29. Dognon, A., and Simonot, V.: Ultraschall und Suspensionen: Thermische und lytische Wirkungen. In Matthes, K., and Rech, W.: Der Ultraschall in der Medizin. Zürich, S. Hirzel Verlag, 1949, vol. 1, pp. 106-113.
30. Harvey, E. N., and Loomis, A. L.: The Destruction of Luminous Bacteria by High Frequency Sound Waves, J. Bact. **17**:373 (May) 1929.
31. Harvey, E. N.; Harvey, Ethel B., and Loomis, A. L.: Further Observations on the Effect of High Frequency Sound Waves on Living Matter, Biol. Bull. Marine Biol. Lab. **55**:459 (Dec.) 1928.
32. Harvey, E. N., and Loomis, A. L.: High Frequency Sound Waves of Small Intensity and Their Biological Effects, Nature, London **121**:622 (Apr.) 1928.
33. Harvey, E. N., and Loomis, A. L.: High Speed Photomicrography of Living Cells Subjected to Supersonic Vibrations, J. Gen. Physiol. **15**:147 (Nov. 20) 1931.
34. Johnson, C. H.: The Lethal Effects of Ultrasonic Radiation, J. Physiol. **67**:356 (July) 1929.
35. Schmitt, F. O., and Uhlemeyer, Bertha: The Mechanism of the Lethal Effects of Ultrasonic Radiation, Proc. Soc. Exper. Biol. & Med. **27**:826, 1930.
36. Böni, A.: Grundlagen der Ultraschalltherapie, Schweiz. med. Wchnschr. **80**:946, 1950.
37. Böni, A.: Le traitement des maladies rheumatismales à l'aide des ultrasons. II. Congreso Europeo de Reumatologica, Barcelona, 9-24-51, Publicaciones Medicas, Jose Janes, Editor, Barcelona.

with a frequency of 175 kcps. The measurement of the ultrasonic intensity was performed with a sound pressure balance (Siemens) and with a calibrated probe. The latter consisted of one soldered junction of a thermocouple, which was inserted into a bead of absorbing material. Some of the animals were treated in a focused ultrasonic beam. The ultrasonic waves were focused by means of two mirrors having different radii of curvature in order to obtain two different intensities at the focus of the sound field. The temperature of the water in which the animals were treated was 30 C. in most experiments. The duration of the irradiation was two minutes.

White mice weighing from 16 to 18 gm. were used. They were irradiated with ultrasonic energy after the hair of the abdominal region had been removed and the skin had been soaped (Pätzold, Güttner and Bastir[38]). The occurrence of petechial hemorrhages in the peritoneal surface of the animals was noted. The number of petechial hemorrhages was recorded. It was also observed whether hyperemia occurred in this area.

When the experiments were performed under an increased pressure, this was raised to the desired level within ten minutes. The pressure was decreased again to atmospheric conditions slowly over a period of one hour in order to prevent damage to the tissues. In a series of 50 animals it was shown that this procedure had no detrimental effect.

We performed the experiments in which the effects of different frequencies were studied according to the method described previously by Lehmann and Nitsch.[39] The reflector of the particular sound pressure balance had a somewhat larger diameter (3 cm.) than that described in the experiments of Lehmann and Nitsch.[39] The animals were treated in these experiments at 42.5 C. for forty-five seconds.

The results of the experiments were evaluated statistically. An observed difference between the average number of petechial hemorrhages per animal in two different series of experiments was regarded as statistically significant only if the quotient

$$\frac{D}{\sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2}}$$

was greater than a value which corresponds to a likelihood of 99.73 per cent (so-called 3 σ equivalent), (Koller[40]). D is the difference of the means; σ_{M_1} and σ_{M_2} are the standard deviations of the respective means. In addition, the percentage of the occurrence of the petechial hemorrhages and hyperemia in each series of experiments was compared. The difference was regarded as statistically significant only if it was greater than the greatest difference which could occur by chance (Koller[40]). The likelihood of 99.73 per cent was also indicative for this comparison.

38. Pätzold, J.; Güttner, W., and Bastir, R.: Beitrag zum Dosisproblem in der Ultraschall-Therapie, Strahlentherapie, **86**:298 (Jan.) 1952.
39. Lehmann, Justus, and Nitsch, Willi: Über die Frequenzabhängigkeit biologischer Ultraschall-Reaktionen mit besonderer Berücksichtigung der spezifischen Temperaturverteilung im Organismus, Strahlentherapie, **85**:606 (Oct.) 1951.
40. Koller, S.: Graphische Tafeln zur Beurteilung statistischer Zahlen. Theodor Steinkopff Verlag, Dresden and Leipzig, 1940.

Experiments

It was necessary to determine whether the petechial hemorrhages used as a test were caused by cavitation. Therefore we irradiated 100 animals with ultrasound at a frequency of 1,000 kcps. under a pressure of 7 atmospheres. The ultrasonic beam was sharply focused by means of the mirror with the smaller radius of curvature and it was directed to the abdomen of the mouse. Another series of 100 animals was irradiated in the same way under atmospheric pressure. As a result the mice treated under the high pressure had an average number of hemorrhages of 2.1, $\sigma_M = \pm 0.7$ per animal, and those irradiated under atmospheric pressure an average of 10.7, $\sigma_M = \pm 1.09$ each.

This dependence of the occurrence of the petechial hemorrhages on the pressure suggested that they were due to cavitation. We checked simultaneously whether or not a hyperemia was observed. According to Lehmann, Vorschütz, Feissel and Nitsch,[39 41 42 43 44 45] this reaction is produced by the thermal component of the ultrasonic effect. Therefore it could be expected that this reaction was independent of the pressure. We found, in agreement with this, a percentage of 81 in the experiment with high pressure and a percentage of 73 in that under atmospheric conditions.

One could expect that the threshold of pressure which prevents the petechial hemorrhages would increase with the rise in ultrasonic intensity (Briggs, Johnson and Mason,[21] Blake[20]). But this assumption would hold true only if the reaction was a result of cavitation. We measured, in these experiments, the ultrasonic intensity in the plane wave before focusing. Then the beam was always focused in the same manner. The mirror with the larger radius of curvature was used, thereby obtaining an intensity of the ultrasonic energy which was less than in the previous experiments. As a result we observed that the threshold of pressure which prevents the reaction is between 3 and 4 atmospheres at the ultrasonic intensity of 2.5 watts per sq. cm. and between 4 and 5 atmospheres at 3.5 watts per sq. cm. (table 1).

TABLE 1. — *Percentage of Occurrence and Average Number Per Animal of Petechial Hemorrhages in 25 Mice at Different Pressures and Intensities.*[a]

Pressure, Atmospheres	Reactions at an Ultrasonic Intensity of	
	2.5 Watts Per sq. cm.	3.5 Watts Per sq. cm.
3	52% 4.8; $\sigma_M = \pm 1.3$	.....
4	0% 0; $\sigma_M =$ ·/·	70% 4.4; $\sigma_M = \pm 1.0$
5	.....	0% 0; $\sigma_M =$ ·/·

[a] Ultrasonic frequency = 1,000 kcps.
σ_M is the standard deviation of the mean.
·/· means that a determination of σ_M is not possible.

The differences of the reactions at different pressures and at the same ultrasonic intensity are statistically significant. The results of these experiments demonstrated again that the reaction was due to cavitation. However, the percentage of hyperemia as a thermal reaction in these experiments remained

41. Lehmann, Justus: Beitrag zur therapeutischen Ultraschall-Wirkung, Strahlentherapie **82**:281, 1950.
42. Lehmann, J.: Über die Temperaturabhängigkeit therapeutischer Ultraschallreaktionen. In Mathes, K., and Reeh, W.: Der Ultraschall in der Medizin. Zürich, S. Hirzel Verlag, 1949, vol. 1, pp. 159-164.
43. Lehmann, Justus, and Vorschütz, Rosemarie: Über die biologische Wirksamkeit des Impulsschalles als Beitrag zum therapeutischen Wirkungsmechanismus der Ultraschallwellen, Strahlentherapie, **81**:639, 1950.
44. Lehmann, Justus, and Feissel, H. J.: Über die Abhängigkeit biologischer Ultraschallreaktionen von der Teilchenamplitude als Beitrag zum therapeutischen Wirkungsmechanismus, Strahlentherapie, **82**: 293, 1950.
45. Lehmann, Justus, and Feissel, H. J.: Inwieweit lässt sich die Ultraschall-Leistung durch Zufuhr von Wärmeenergie in ihrer biologischen Wirkung ersetzen? Strahlentherapie, **85**:615 (Oct.) 1951.

the same after irradiation with the same intensity, regardless of the changes in pressure.

In case the observed hemorrhages were produced by cavitation, we could then expect, furthermore, a dependence on the ultrasonic frequency. According to Sörensen[25] and to Möller and Schoch,[22] the effect of cavitation decreases with the increase of the ultrasonic frequency. We irradiated two series of 20 animals each with an ultrasonic intensity of 1.2 watts per sq. cm. and with the ultrasonic frequencies of 1,000 kcps. and 175 kcps. The duration of the treatment was forty-five seconds. The temperature of the surrounding water was 42.5 C. instead of 30 C. as in the other experiments. The higher temperature was necessary to produce a higher percentage of reactions at the low intensity which was available at 175 kcps. (The dependence of the effect on temperature will be discussed later on.) As a result of these experiments it was found (table 2) that the percentage of

TABLE 2. — *Dependence of Petechial Hemorrhages on Ultrasonic Frequency.**

Ultrasonic Frequency, kcps.	Percentage of Occurrence of Petechial Hemorrhages	Number of Petechial Hemorrhages Per Animal
175	70%	$4.6; \sigma_M = \pm 0.9$
1,000	15%	$0.8; \sigma_M = \pm 0.4$

* 20 animals in each series.

the reactions is markedly increased at the lower frequency. This result supported again the assumption that the observed biologic effect was due to cavitation. In these experiments with different frequencies, all other physical conditions with the exception of the rise of temperature in the tissues were the same. According to the experiments of Lehmann and Nitsch,[39] most of the biologic effects decrease with the drop of ultrasonic frequency because they are created by the thermal component of the ultrasonic effect. The coefficient of absorption and therefore the rise of temperature is less, the lower the frequency (Pohlman,[46] Hüter[47,48]). In experiments comparing the effect of the different frequencies, one might expect that the greater rise of temperature at the higher frequency facilitated the occurrence of degassing and cavitation (Blake[20]). However, a converse dependence of the biologic effect on the frequency was observed. This result is therefore sufficient evidence that the reaction is created by cavitation.

Finally, we could demonstrate in the following series of experiments that the ultrasonic irradiation produced an alteration in the tissues which was not immediately visible. Thirty mice were irradiated with an intensity of 2 watts per sq. cm. and an ultrasonic frequency of 1,000 kcps. and without focusing the beam. Petechial hemorrhage was found in 33 per cent of the animals. The average number of hemorrhages per mouse was 3.4; $\sigma_M = \pm 1.2$. Another series of 30 mice was exposed to ultrasound with the same technique, and immediately following this procedure the animals were subjected to a pressure of 7 atmospheres for two minutes. Afterwards, the pressure was reduced to 1 atmosphere within five seconds. The percentage of reactions in this series was 100 per cent. The average number of petechial hemorrhages per animal was increased to 23.2; $\sigma_M = \pm 3.9$. The differences between the results of these two series are statistically significant. As a

46. Pohlman, R.: Über die Absorption des Ultraschalles im menschlichen Gewebe und ihre Abhangigkeit von der Frequenz. Phys. Z. **40**:159, 1939.
47. Hüter, T.: Messung der Ultraschallabsorption in tierischen Geweben und ihre Abhängigkeit von der Frequenz. Naturwissenschaften. **35**:285, 1948.
48. Hueter, T. F.: On the Mechanism of Biological Effects Produced by Ultrasound. Chemical Engineering Progress Symposium, Series Vol. 47, No. 1:57, 1951.

control a third series of 30 mice was exposed to the same pressure in the same way, but the mice had not been irradiated previously with ultrasonic energy. No reaction was observed.

The interpretation of these observations is difficult. However, two explanations are conceivable. On the one hand, the cavitation may cause a local damage to the wall of a blood vessel which cannot be observed until the gradient of pressure between the contents of the vessel and the surrounding tissue during the rapid reduction of the applied high pressure creates the hemorrhage. On the other hand, the degassing effect of the rapid release of pressure may rupture the wall of the vessel (National Research Council, Decompression Sickness, 1951). However, this can occur only if the tissue has been damaged previously, as for instance by the thermal effect of ultrasonic energy (Lehmann, Vorschütz, Hohlfeld, Otto, Becker and Jaenicke[49-50-51-52-53-54-55-56-57-58-59-60]). If such a thermal effect of ultrasonic energy existed in these experiments, it could be expected that the effect of cavitation was dependent on the temperature. Furthermore, a dependance of the reaction on temperature could be assumed because cavitation occurs more easily in a medium containing dissolved gas when the temperature is higher. If the temperature rises, not quite as low a pressure is required in the ultrasonic waves during the phase of rarefaction in order to produce degassing or cavitation (Blake[20]). It is known that the solubility of the gas decreases with rising temperature. Also, the formation of tiny bubbles of gas or vapor is promoted (Pohlman[21]). The temperature of the irradiated region is, on the other hand, dependent on various factors (Lehmann[61]).

We investigated the dependence of the effect of cavitation on temperature in the following way. Two series of 20 animals were irradiated, each with an intensity of 1 watt per sq. cm. and an ultrasonic frequency of 1,000

Table 3. — *Dependence of Petechial Hemorrhages on Temperature.**

Temperature of the Water During Irradiation	Percentage of Occurrence of Petechial Hemorrhages	Number of Petechial Hemorrhages Per Animal
30° C.	0%	0; $\sigma_M = \cdot/.$
43° C.	80%	25; $\sigma_M = \pm 5.9$

* 20 animals in each series.

kcps. at 30 C. and 43 C. for two minutes. The radiating surface of the applicator was 10 sq. cm. The results represented in table 3 demonstrate that the observed effect of cavitation is dependent on the temperature.

49. Lehmann, J. F.: Ultraschallbehandlung. Die Umschau. 49:609, 1949.
50. Lehmann, Justus: Die biophysikalischen Grundlagen der Ultraschalltherapie. Verhandl. d. deutsch. Gesellsch. f. inn. Med. 57:416, 1951.
51. Lehmann, Justus: Die Spezifität der biologischen und therapeutischen Ultraschallwirkung. Arch. f. phys. Therap. 3:57 (Mar.-Apr.) 1951.
52. Lehmann, J. F.: Ueber biophysikalische Grundlagen therapeutischer Ultraschallwirkungen. Supplemento al Vol. VII, Serie IX, del Nuovo Cimento, 1950.
53. Lehmann, Justus: Die biophysikalischen Grundlagen therapeutischer Ultraschallwirkungen. In Woeber, Karlheinz: Der Ultraschall in der Medizin. Zürich, S. Hirzel Verlag, 1950, vol. 2, pp. 5-9.
54. Lehmann, Justus: Über die Temperaturabhängigkeit therapeutischer Ultraschallreaktionen unter besonderer Berücksichtigung der Wirkung auf Nerven. Strahlentherapie. 79:513, 1950.
55. Lehmann, Justus, and Vorschütz, Rosemarie: Die Wirkung von Ultraschallwellen auf die Gewebeatmung als Beitrag zum therapeutischen Wirkungsmechanismus. Strahlentherapie. 82:287, 1950.
56. Lehmann, J. F., and Hohlfeld, R.: Der Gewebestoffwechsel nach Ultraschall und Wärmeeinwirkung. Strahlentherapie. 87:544, 1952.
57. Lehmann, Justus, and Becker, Georg: Über die permeabilitätssteigernde Wirkung von Ultraschallwellen auf biologische Membranen. Strahlentherapie. 79:1553, 1950.
58. Lehmann, Justus, and Vorschütz, Rosemarie: Die Wirkung von Ultraschallwellen auf die Gewebeatmung als Beitrag zum therapeutischen Wirkungsmechanismus. Strahlentherapie. 82:278, 1950.
59. Lehmann, Justus; Becker, Georg, and Jaenicke, Walther: Über die Wirkung von Ultraschallwellen auf den Ionendurchtritt durch biologische Membranen als Beitrag zum Theorie der therapeutischen Wirkungsmechanismus. Strahlentherapie. 83:311, 1950.
60. Lehmann, J. F.; Becker, G., and Otto, J.: Thermische und mechanische Wirkungen des Ultraschalles auf einzelne Zellen, untersucht am Beispiel der eosinophilen Leucocyten. Strahlentherapie. 87:550, 1952.
61. Lehmann, J. F.: Die Beziehungen zwischen therapeutischer Dosis und biophysikalischer Wirkung der Ultraschallwellen. In Woeber, Karlheinz: Der Ultraschall in der Medizin. Stuttgart, S. Hirzel Verlag, 1951, vol. 3, p. 24.

All the experiments described previously suggested that the observed petechial hemorrhages are due to cavitation. Therefore the question arose whether the microscopic appearance of the lesion was in agreement with the fact that the highly destructive forces of cavitation produce a more or less local damage in the vicinity of the collapsing cavities or oscillating gas bubbles. Such petechial hemorrhages at the intestinal interfaces in rats have already been described by Schröder, Herrick and Karlson.[62] We studied microscopic sections of the intestines after ultrasonic irradiation. The tissues were fixed immediately after the ultrasonic treatment and serial sections

Fig. 1. — Ruptured blood vessel in the intestinal wall (hematoxylin and eosin; X150).

were made. It was found that the larger vessels were ruptured locally (figs. 1 and 2). No defect was observed in serial sections made within a short distance from this particular locality (for example, fig. 3). The leakage in smaller blood vessels and capillaries could not be localized exactly. However, in figure 4 one can see that the blood leaks out of the mucous membrane between two villi at a circumscribed spot. Other structures are also destroyed locally. The epithelial layer and the glands of the mucous membrane were damaged and surrounded by a hemorrhage (fig. 5). In some places the damage was so severe that the whole structure of the tissue and of the cells had vanished (fig. 6). Large empty spaces were found, which

62. Schröder, J. D.; Herrick, J. F., and Karlson, A. G.: The Effect of Ultrasound on the Transmissible Walker Rat Carcinoma, Arch. Phys. Med. 33:660 (Nov.) 1952.

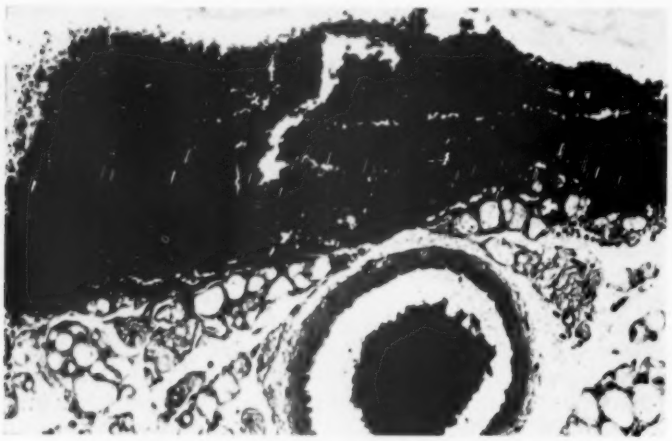


Fig. 2. — Ruptured blood vessel of the mesentery with hemorrhage (hematoxylin and eosin; X200).

presumably might correspond to gas bubbles. The epithelial layer looked as if it were torn. The erythrocytes of the surrounding hemorrhage were partially hemolyzed. In addition, hemorrhages were found in other tissues, as for instance in the lymph nodes. All these local effects have a diameter of the order of 10 to 100 microns. Other effects, such as highly dilated blood vessels and a slight edema, were observed all over the sections. Controls, treated in the same manner without ultrasonic irradiation, showed none of these findings. As a whole the histologic appearance was in good agreement with the assumption that these hemorrhages observed macroscopically were created by the circumscribed but terrific forces of cavitation.

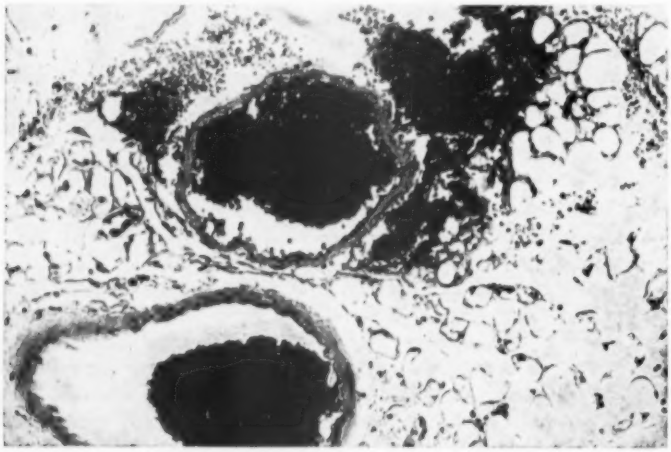


Fig. 3. — Another section through the same vessel as in figure 2, with remnant of the hemorrhage but no rupture of the vessel wall. The distance between these sections is approximately 50 microns (hematoxylin and eosin; X200).

Fig. 4. — Hemorrhage into the intestinal lumen with destruction of the epithelium between two villi (hematoxylin and eosin; X125).

Since it could be demonstrated that the petechial hemorrhages observed at the peritoneal surface were due to cavitation, the question arose whether this primarily detrimental effect of ultrasonic irradiation occurs under a set of circumstances such as used in therapy. Therefore it was necessary to find out what were the thresholds of ultrasonic intensities for this reaction. Since our subject of investigation was a small animal, it can be assumed that the thresholds found with stationary transducer and with moved applicator are lower than, or at least the same as, in man. That is because the interfaces

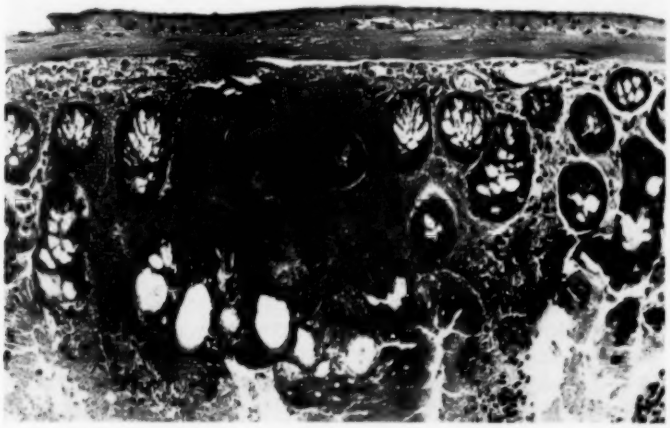


Fig. 5. — Destruction of intestinal glands and epithelium with surrounding hemorrhage (hematoxylin and eosin; X160).

(for example, tissue-air) of the peritoneum are covered only by a thin layer of tissues. As a result of the reflection at these interfaces, cavitation is produced more easily (Sörensen[25]). Furthermore, the rise of temperature is greater in the small animal than in man because the conduction of heat and the regulation of temperature are not sufficient under the circumstances of our experiments. The higher temperature also enhances the occurrence of cavitation. Therefore it could be expected that only a minimal intensity for the threshold of this reaction would be found. But this value is sufficient

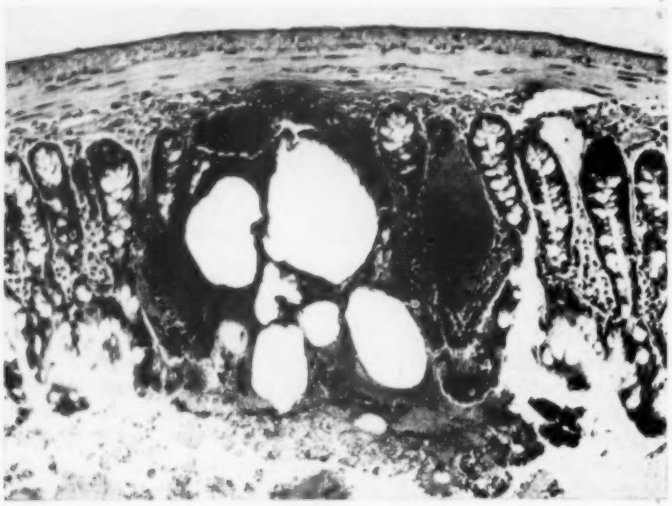


Fig. 6. — Destruction of the mucous membrane of the intestine with hemorrhage and formation of "bubbles" (hematoxylin and eosin; X120).

to provide information concerning the intensity of irradiation to which man may be safely exposed.

Two series each containing 40 animals were treated with an ultrasonic frequency of 1,000 kcps. and with nonfocused intensities of 1 watt per sq. cm. and 2 watts per sq. cm., respectively, for two minutes (table 4). Stationary

TABLE 4. — *Thresholds of Intensities of the Reactions Under Different Techniques.**

Conditions of Treatment	Percentage of Occurrence of Petechial Hemorrhages	Number of Petechial Hemorrhages Per Animal
1 watt per sq. cm. for 2 minutes, stationary technique	0%	$0; \sigma_M = \cdot/.$
2 watts per sq. cm. for 2 minutes, stationary technique	45%	$7.1; \sigma_M = \pm 1.6$
4 watts per sq. cm. for 4 minutes, pulsed irradiation	0%	$0; \sigma_M = \cdot/.$

* 40 animals in each series.

technique with continuous energy was used. Another series of 40 mice was irradiated for four minutes with pulsed energy having an output of 4 watts per sq. cm. (during the pulse). The attempt was made to approximate the effect of a moved transducer by pulsed irradiation (Bender, Herrick and Krusen[63]). The duration of the pulses was 0.1 second and that of the pauses 0.3 second. These values correspond to the period of time and sequence with

63. Bender, L. F.; Herrick, J. F., and Krusen, F. H.: Unpublished data.

which an area of 1 sq. cm. of the tissue is exposed to the ultrasonic beam, providing stroking technique is used. Therefore the total amount of ultrasonic energy applied to tissues under these conditions was the same as in the experiment with stationary technique and 2 watts per sq. cm. As a result the threshold of the intensity is found between 1 watt per sq. cm. and 2 watts per sq. cm. at stationary technique. No reaction is encountered with pulsed irradiation up to and including 4 watts per sq. cm. These values are just higher than those ordinarily used in therapy (Lehmann[3]).

Finally, a question arose concerning the types of ultrasonic machines used in therapy. The voltage at the quartz crystal in some equipment is not steady as it is in most of the generators, but it is modified with the frequency or the double frequency of the alternating house current (half-wave and full-wave rectification). It is of interest to find out whether the resulting peak values of the ultrasonic intensity exceeded the threshold of cavitation. Two series of 20 animals each were treated with 1,000 kcps. and with an average intensity of 1.5 watts per sq. cm. for two minutes. The intensity was determined with an ultrasonic pressure balance, which measures the average value because of the inertia of the system. The average and peak values are identical in case of a steady voltage at the crystal but not in case of the modulated voltage. In the latter case we removed the condensers from the rectifiers of the "ultrasonator" in order to procure a modulated voltage at the crystal. The comparison of the results in table 5 shows that the reactions

TABLE 5. — *Comparison of Petechial Hemorrhages With a Steady and Modulated Voltage at the Crystal.**

Conditions of Treatment	Percentage of Occurrence of Petechial Hemorrhages
1.5 watts per sq. cm. steady voltage at the crystal	5%
1.5 watts per sq. cm. modulated voltage at the crystal	55%

* 20 animals in each series.

are more easily produced by the high peaks of ultrasonic intensity, in spite of the fact that the average intensity and all other conditions were the same in both experiments.

Petechial hemorrhages were observed at the peritoneal surface of our animals after ultrasonic irradiation. It could be shown that these hemorrhages occur as a result of a rupture of vessels due to the high local concentration of energy produced by cavitation. According to Sollner,[26] it can be assumed that these reactions occur chiefly at the peritoneal interfaces. According to the experiments of one of us (Lehmann[17]), it is likely that cavitation takes place mainly in the blood vessels, since blood has a relatively low viscosity and also a relatively low volume percentage of cells. The assumption that the observed petechial hemorrhages are due to cavitation can be demonstrated by the following facts: 1. The occurrences of the reaction depends on the pressure, while the effect of the thermal component due to absorption, as for instance the hyperemia, was not altered. 2. In order to prevent the reaction it is necessary to apply high pressures. The greater the ultrasonic intensity, the higher the pressure must be in order to prevent cavitation. 3. The occurrence of the petechiae was dependent on the ultrasonic frequency in the same way as is the cavitation. 4. The same holds true for the dependence on temperature.

The observed effect of cavitation represents a damage to the tissues which

also has been found in man after an application of an unsuitable dose (Krauspe[64]). Therefore it was necessary to answer the question whether the occurrence of cavitation could be expected under therapeutic conditions. It was of interest to know which ultrasonic intensities, applied with the two types of techniques ordinarily used in therapy, produced cavitation. Thus the question was raised as to which intensities can be employed with the stationary and with the moved applicator without injuring the tissues (Lehmann[65]). Intensities below the threshold of the reaction in our experiments should be safe, because the cavitation is more readily created in a small animal than in a human being. The thresholds found in these experiments are in good agreement with the recommended doses for therapy. The assumption of Pohlman[21] that cavitation occurs under therapeutic conditions in the living tissue could not be corroborated. This result was also expected (Lehmann[17]), because most effects of cavitation are destructive (Grabar and Rouyer,[13] Grabar and Prudhomme[14-15-16]).

The fact that cavitation does not occur during an ultrasonic irradiation with pulses of relatively long duration and with a sufficiently high intensity can be explained by the dependence of the reaction on temperature. The latter was demonstrated in our experiments.

Summary

Petechial hemorrhages at the peritoneal surface of the mouse were described as a result of cavitation. This biologic reaction was influenced by the physical conditions in the same way as was cavitation. It was repressed on the application of high pressure during irradiation. The threshold of pressure which just prevented the reaction increased with the increase of ultrasonic intensity. The reaction was dependent on frequency. It could be created more readily with lower than with higher ultrasonic frequencies. Finally, the biologic effect depended on temperature. The higher the temperature, the more reactions were observed. The hemorrhages were histologically the result of a local rupture of vessels.

Since these effects are detrimental, the threshold of intensity with the different techniques used in therapy was determined. In agreement with the doses recommended for therapy, it was found that this threshold is between 1 and 2 watts per sq. cm. with the stationary technique. When the applicator is moved, this threshold is above 4 watts per sq. cm.

Concerning the ultrasonic generators used in therapy, it was found that those with a steady voltage at the crystal could be used safely. The high peaks of intensity produced by the other machines when the fluctuations of the alternating current were not filtered properly might possibly exceed the threshold of cavitation.

64. Krauspe, Carl: Histologische Beobachtungen nach Ultraschallbehandlung eines chronischen Magengeschwürs und bei der Resorption eines traumatischen Hämatoms, Frankfurter Zeitschrift für Pathologie. 63:71 (Jan.) 1952.

65. Lehmann, J. F.: Ist die Kenntnis der biophysikalischen Wirkungsmechanismus der Ultraschalles zur Vermeidung von Schädigungen bei der Therapie notwendig? In Woeber, Karlheinz: Der Ultraschall in der Medizin. Stuttgart, S. Hirzel Verlag, 1952, vol. 1, p. 34.

A FOREARM-FLEXION DEVICE FOR THE PARALYZED UPPER EXTREMITY WITH POTENTIALLY FUNCTIONAL HAND *

DAVID RUBIN, M.D., Ph.D.[1]
O. LEONARD HUDDLESTON, M.D., Ph.D.[2]
HYMAN JAMPOL, M.S., R.P.T.[3]
PATRICIA MARTIN, O.T.R.[4]
and
ROBERT TAYLOR[5]

Introduction

The poliomyelitis patient with a completely or partially paralyzed upper extremity and a potentially functional hand has been encountered with sufficient frequency in our poliomyelitis rehabilitation program to cause speculation as to the application of the principles of upper extremity prosthetics to this problem.

In the spring of this year the senior author attended a series of lectures on recent advances in upper extremity prosthetics, sponsored by the Engineering Artificial Limbs Research Project of the University of California at Los Angeles. It was during this period that the possibility of this application became more apparent and resulted in a joint effort which was successful in developing a simple, inexpensive and extremely useful forearm-flexion device for such patients. The forearm-flexion device to be described was developed for a sixteen year old poliomyelitis patient who was acutely ill in August, 1950. On admission to the Kabat-Kaiser Institute for Neuromuscular Rehabilitation in September, 1950, he exhibited marked to moderate weakness of both upper extremities, the neck, the trunk and both lower extremities. Following approximately twenty months of treatment improvement was obtained in all muscle groups; however, the right shoulder flexors and abductors and the forearm flexors remained extremely weak, especially in the first part of the range of voluntary motion. These muscles also continued to show rapid fatigue in the shortened range so that the patient could not maintain forearm flexion and wrist extension while typing, and could not lift a one-half pound weight unless he assisted with the left hand. A muscle check in April, 1952, revealed three plus weakness of the right deltoid, the infraspinatus and supraspinatus and biceps muscles. It was at this point in the patient's muscle re-education program that the forearm-flexion device was developed for his use.

Component Parts of the Device

The component parts of the forearm-flexion device consisted of: 1. The shoulder harness. 2. The arm and forearm cuff. 3. The cable housing and 3/64-inch cable. 4. Retainers and base plates. 5. Rubber reinforcement. 6. Hangers. 7. Swivel fitting. 8. Leather stabilizing straps.

The harness is made of one inch vinyon tape. It consists of two shoulder

* A joint project of Engineering Artificial Limbs Research, University of California at Los Angeles, and the Kabat-Kaiser Institute for Neuromuscular Rehabilitation, Santa Monica, California.
1. Staff Physician, Kabat-Kaiser Institute for Neuromuscular Rehabilitation.
2. Resident Medical Director, Kabat-Kaiser Institute for Neuromuscular Rehabilitation.
3. Assistant Engineer, Engineering Artificial Limbs Research, University of California.
4. Kabat-Kaiser Institute for Neuromuscular Rehabilitation.
5. Prosthetist Engineering Artificial Limbs Research, University of California, Los Angeles, California.

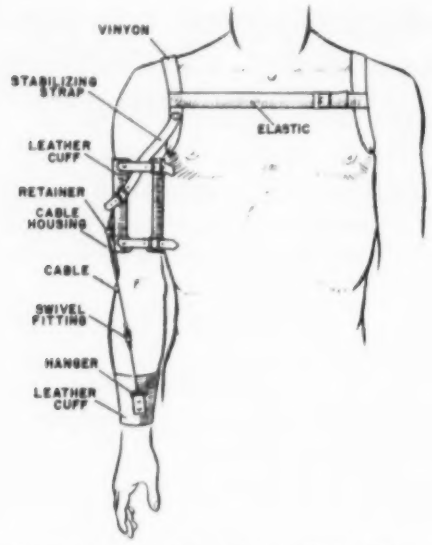


Figure 1. — Front view of Forearm-Flexion Device.

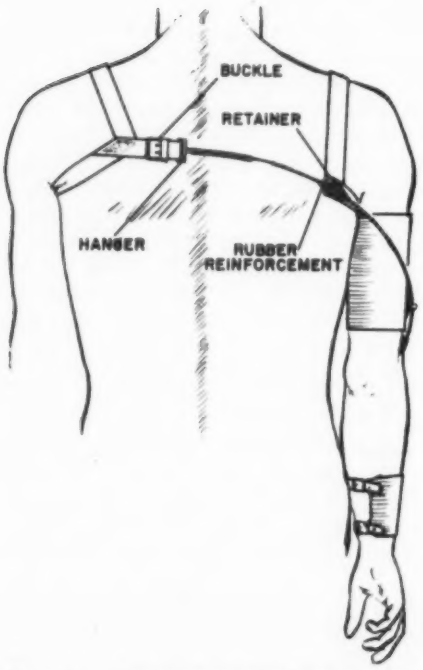


Figure 2. — Back view of Forearm-Flexion Device.

loops joined by an elastic or webbing chest strap in front and utilizes the left shoulder loop posteriorly as a stabilization point for the cable attachment (figs. 1 and 2).

The cuffs are made of leather similar to that used in other orthopedic appliances. The arm cuff is supported and prevented from rotating by two adjustable leather straps — one anteriorly and laterally, and the other posteriorly and medially — coursing from the anterior and posterior parts of the right shoulder loop (fig. 1). This is a variation of the inverted "Y" used in below elbow prosthetics.[1]

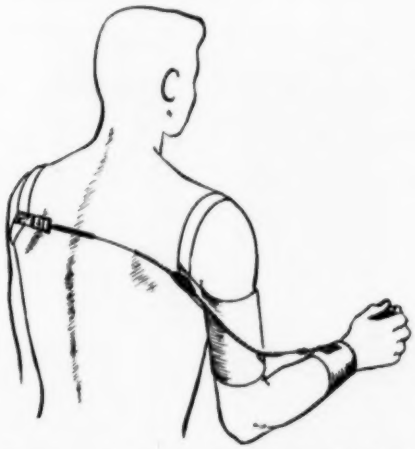


Figure 3. — ¾ back view showing forearm flexed and scapulae abducted.

The cable housing and cable are all metal and may be obtained from the Sierra Manufacturing Company, Sierra Madre, California, or from any limb manufacturer by requesting 3/64 inch cable and round cable housing.

Retainers and base plates are used on the right shoulder loop and on the arm cuff. The base plate on the shoulder loop is riveted to a piece of leather and fastened to the vinyon tape posteriorly, as shown in figure 2. The retainer used on the shoulder loop is fixed in a rubber reinforcement through which the cable housing passes.

A rubber reinforcement is used on the right shoulder strap posteriorly to permit gradual bending of the cable housing and cable, thereby decreasing the friction in the cable system.

Hangers serve as anchoring points for the cable, proximally at the left posterior shoulder loop and distally at the forearm cuff (figures 1 and 2).

Swivel fittings are used to permit easy rotation of the cable in pronation and supination and to enable easy disengagement of the device by the opposite hand. The swivel fitting is placed three to four inches above the point of the attachment of the cable to the hanger on the forearm cuff (figures 1 and 3).

Leather stabilizing straps (figure 1) are used to prevent rotation of the upper cuff postero-laterally as the cable is tensed in forearm flexion. These straps are also of value in maintaining the vertical position of the cuff, and obviate the

1. Proceedings of the Institute on Upper Extremity Prosthetics, University of California, Los Angeles, January, 1957.

need for excessive tightening which may lead to circulatory embarrassment. The straps are fastened as outlined in discussion of the arm cuffs.

Figures 4, 5 and 6 show the device as it appears on the patient.

Discussion

The application of recent advances in upper extremity prosthetics for amputees to poliomyelitis patients with completely or partially paralyzed upper extremities retaining a potentially functional hand has resulted in a simple, relatively inexpensive forearm-flexion device. Through the use of this device one of our patients has achieved a degree of function in useful activity not previously anticipated. Writing, typing and unilateral lifting of fairly heavy objects has been facilitated immeasurably. Bilateral upper

Figure 4. — ¾ front view of Forearm-Flexion Device.

Figure 5. — Back view of Forearm-Flexion Device.

extremity activity not previously possible has been restored. This has been especially useful in school laboratory work requiring two handed dexterity. Another very interesting development in this patient has been the improvement observed in biceps muscle power after using the forearm-flexion apparatus for two months. This may be explained by the more favorable position for motion in which the forearm is placed and supported, as well as by the increased activity against resistance. This device is extremely light in weight, easily put on and removed, and cosmetically ideal. A long sleeved shirt will hide all of the component parts and bulging is very slight and almost imperceptible.

TABLE 1. — *Joint Torque Curves. (Isometric Forces Exerted at Various Angles of Forearm Flexion.*)*

Angle (Degrees)	Forces (lbs.)
0	<0.5
45	0.5
90	2.0
120	4.0
135	6.0
Full	3.0

* Lever arm = 8.75 inches from lateral epicondyle.

The source of power for the operation of the prostheses can be varied to utilize the most effective muscular and joint movement. Two basic body control motions are used to activate upper extremity prosthetics as follows: (1) flexion of the humeral stump and (2) flexion of the opposite shoulder coupled with flexion of the shoulder on the amputated side. Inasmuch as this patient was unable to use the humeral flexors because of weakness it was decided to utilize flexion (scapular abduction) of the opposite shoulder as the motive power to operate the device. This motion serves to increase the interscapular dimensions and thereby to displace the cable through a sufficient distance and with adequate force to produce forearm flexion.

Figure 6. — ¾ front view with forearm flexed.

TABLE 2. — *Operating Forces* and Excursion Needed.†*

Angle (Degrees)	Forces (lbs.)	Angle of Motion	Excursion (Inches)
0	4	0 — 45°	2.250
45	5	0 — 90°	3.875
90	6		

* Force necessary to move forearm from the position indicated.
† Excursion necessary to move forearm through the range of motion indicated. (Maximum excursion possible = 4.5 inches.)

Table 1 illustrates the force* that the patient is able to exert at various degrees of forearm flexion. It is readily seen that the maximum force (<0.5 lbs.) exerted at the beginning of the range precludes voluntary forearm flexion from the fully extended (0 degree) position. However, if the forearm is brought to the 90 degree position the patient is then able to bring his hand to his mouth. Table 2 lists the forces and excursion necessary to produce forearm flexion in the patient while wearing the device. It is readily observed that the forces are of small magnitude and easily attained through the body control motion utilized. The excursions required are also well within the range of the patient's maximum excursion.

Through practice in the use of the device this patient has learned to flex

* Force measurements obtained using SR-4 strain gauges and electronic strain analyzer.

his right forearm with almost imperceptible movement of the opposite shoulder. By proper harnessing other normal joint movements may be exploited to produce the desired excursion and force for successful function. It is anticipated that with experience and further modification wider application will be achieved in more severely involved cases and in a greater variety of neuromuscular dysfunctions involving the upper extremities.

Acknowledgment. — The authors wish to express their thanks to Mr. W. R. Santschi for his excellent line drawings and to Mr. Ed Morgan for the photographic contribution.

REHABILITATION IN THE CLINICAL MANAGEMENT OF THE PATIENT WITH TUBERCULOSIS *

EDWARD E. GORDON, M.D.†

NEW YORK, N. Y.

To the great physician, Osler, is attributed the statement, "Tuberculosis is a social disease with medical aspects." This is the theme which will run through this paper and I have made this choice because it denotes so eloquently the rationale for total rehabilitation, for one cannot discuss the management of tuberculosis without constantly referring to the patient as a member of a social organization.

No attempt will be made to describe the duties of an ideal rehabilitation team in an ideal setting as applied to an ideal patient. This has been done already in word and film. Rather, this paper will present several major problems inherent in the fight against tuberculosis, not only to illustrate the varied social and economic implications of the disease, but to reveal the importance of a rounded rehabilitation program from beginning to end. These problems may be listed as, (1) the associated environmental causes of tuberculosis, (2) leaving a hospital against medical advice, (3) the assessing of work capacity, (4) vocational training and placement.

The changing pattern of tuberculosis in the population of this country in the past one hundred years holds a promise. Thus, in 1900, 150,000 people died of tuberculosis, or 195/100,000; in 1948, 44,000 or only about 30 out of every 100,000 died of the same cause. This favorable trend is reflected in the fact that in 1900 tuberculosis was the top killer; in 1947 it had sunk to seventh place in importance. What has accounted for this dramatic fall in mortality rate? Dubos ascribes it to what he calls the "sanitary revolution" in the train of social reform of the past one hundred years. Better nutritional, sanitary and working conditions have created a more favorable environment and healthier individual to resist the white plague. This fact illustrates that advances in medicine may originate in entirely unexpected quarters and that social and purely medical factors may not be unrelated. One of the most striking community experiments in his regard was reported from Japan. In an industrial town, where the mortality rate from tuberculosis was extremely high, measures taken to supply an adequate nutrition to the population resulted in a fall of 78 per cent in the number of deaths.[1] Such experiences lead

* Read at the Thirtieth Annual Session of the American Congress of Physical Medicine, New York, N. Y., Aug. 26, 1952.

† Associate Professor of Rehabilitation Medicine, College of Physicians and Surgeons, Columbia University, New York.

1. Saiki, T.: II Congrès Scientifique International de l'Alimentation, Paris, 1937.

one to ask whether the so-called innate low resistance of certain ethnic groups is not really an expression of poor environmental living conditions, since they have not wholly enjoyed the benefits of the sanitary revolution. If further inroads are forthcoming against the death rate, the curve of which is now asymptotic for the past score of years, perhaps an even greater broadening of the standard of living is necessary. One must look to the contributions of the social engineer, as well as to those of the clinician, immunologist, and biochemist for eradication of tuberculosis.

If the promise of ultimate control, as reflected in the mortality statistics, is to be realized, the population within the sanatoria must receive comprehensive management, insuring as complete physical and social restoration as may be possible. This brings us to the second problem. The natural history of tuberculosis remains basically unmodified. No dramatic bactericidal drugs are at hand as in pneumonia, and, for the present, antibiotics and chemical agents may be counted upon only to stay progress of the disease and thus help healing by rest, collapse therapy and excisional surgery. Treatment is slow and prolonged, giving rise to fear, family dislocation, economic insecurity and maladjustment. Added to these may be the feelings of shame and ostracism. To such psychological and social pressures are patients subjected, especially in their first period of hospitalization.

This period may be termed "the period of adjustment to life in a hospital bed." During this time the problem of irregular discharge or leaving against medical advice assumes paramount importance. In 1947, of all living discharges from VA hospitals[2] and four municipal hospitals of New York City,[3] over 50 per cent did not receive regular discharge from the medical staff. Analyses of the figures was revealing. Study of the characteristics of patients irregularly discharged showed that those over thirty were the more likely to leave. The number of married females was higher than that of their single sisters; while the divorced or widowed status further increased the chances of leaving against advice. The public health danger inherent in irregular discharge was not inconsiderable: one-half of the patients so discharged had tubercle bacilli in their sputum; and 97 per cent still showed unsatisfactory clinical progress. And, significantly enough, the studies disclosed that half of those leaving against advice left within the first ninety days of hospitalization.

The reasons for premature departure from the sanatoria could be reduced to the least common denominators of dissatisfaction and anxiety. There were dissatisfaction with the institution and personnel; dissatisfaction with the care and routine of the hospital; dissatisfaction with the individual progress of the disease. Anxieties constantly disturbing peace of mind arose; domestic, financial and social difficulties served to act as forces tugging on the patient from without. Fortunately, these causes for irregular discharge are states of mind which are amenable to proper management. Fortunately, too, such causes as alcoholism, immaturity and complete hopelessness, which are far less amenable to treatment, played minor roles as contributory factors.

From these analyses, the problem of irregular discharge cannot be considered as due to the vagaries of human nature, but rather to justifiable human reactions to the demands of the disease. The patient leaves his mode of life for the sanatorium for a protracted stay. Families are dislocated, financial insecurity looms, domestic difficulties arise. Added to these is the effect of

2. VA Pamphlet 10-27, October, 1948, Washington 25, D. C.
3. Drolet, S. J.: A Statistical Summary for the Five Years, 1945-1949, New York Tuberc. & Health Assoc., 1950.

inactivity, itself, which has been shown to produce tension, anxiety, hostility and resentment.[4]

It would appear that, in order to stem the tide of irregular discharge, the machinery of rehabilitation must be set into motion directly upon admission. Just as the medical work-up is immediately begun, so a social and personal work-up must be initiated, this procedure embracing both the patient and the family. Overall management requires:

(1) A complete history involving the social, economic, educational and vocational background. An exhaustive psychological picture may be deferred until it is deemed necessary, but, at least, a sketch of the personality should be drawn.

(2) Adequate and early attention to various pertinent problems of the patient and family by social service.

(3) An educational program to reach the family. Discussion, singly or in groups, may prevent ill-timed advice being given to the patient by his relatives.

(4) Adequate nursing and medical care. This need not concern us here, since standards are universally high.

(5) Most important, early and concentrated health education. This activity should include not only the public health aspects of tuberculosis, but also what is required of the patient, if the cure is to be given a fair trial. In a chronic disease, such as diabetes, great pains are taken to enlist the cooperation of the patient by explaining to him the pertinent details of the disease. It appears wise, similarly, to follow the same general approach in tuberculosis. The educational program should include not only lectures and visual material, but also personal talks by the rehabilitation workers.

(6) Intelligent use of work therapy and recreation. Vocational rehabilitation at this time in the disease would be premature, but, if medically feasible, cooperation of the patient may be enlisted through the exploitation of his interests.

We shall now turn to the period of gradual restoration of work tolerance. Roughly, this period begins in the hospital and extends over into post-hospital life. How to assess the work capacity of individuals, how much activity to prescribe are important and delicate decisions in the management of the patient, since work tolerance can be determined only in retrospect. If one could readily measure work capacity, the problem of gradually adjusting the activity to the patient would offer no difficulty. But work capacity is a heterogeneous concept composed of physiological, psychological and environmental factors, and is difficult, if not next to impossible, to measure.

The assessment of work capacity, though eluding exact measurements, can be dealt with indirectly through a familiarity with the approximate physiologic stress associated with a given physical task. The degree of physiologic stress may be judged from the rate of energy cost required to accomplish a given task. The magnitude of this cost may help the clinician in forming a decision as to the wisdom of prescribing it in the light of the pertinent clinical, bacteriologic and roentgenologic data. Values of rates of energy cost for many activities in which hospitalized patients may be expected to participate have already been published.[5]

More important for the future physical and social restoration is the type of task chosen for the patient in the latter period of hospitalization. It makes no sense to talk about work capacity unless we ask the question, "Work capacity for what?" Merely to prescribe physical activity for its own sake, e. g., walking, is to operate in a vacuum. The logic of the situation demands that increase in work tolerance be done with a planned, realistic goal in mind: a vocation which will afford ultimate social restoration of the patient. This will tend to minimize dissatisfaction and lack of cooperation in the hospital; to avoid "industrial (not physiological) fatigue" — occasioned by disinterest or ineptness in the prescribed task — and, ultimately perhaps, recurrence of disease at a future date.

4. Dietrick, John E.; Whedon, G. Donald, and Shorr, Ephraim: Effects of Immobilization Upon Various Metabolic and Physiologic Functions of Normal Man. Am. Jour. Med. 4:3, 1948.

5. Gordon, E. E.: Energy Costs of Various Physical Activities in Relation to Pulmonary Tuberculosis. Arch. Phys. Med. 33:201 (April) 1952.

The method of fitting a graded tolerance program to the individual needs clinical support. At the outset, no routine system can possibly apply, because tuberculosis is a highly individual disease. When to start and how much to give requires familiarity with several factors: (1) The total age of the disease, and its anatomical extent, (2) The probable time of the evolution of the disease up to initiation of treatment, (3) The length of time for stabilization, i. e., the response to treatment. In the light of excisional surgery, more and more in use today, another factor comes into prominence, viz., (4) Eradication of active foci by surgery. This fourth proposition is highly important, because it, too, has a bearing on the incidence of recurrence. Previous to the practice of excisional surgery, foci appearing inactive by x-ray were judged stabilized, i. e., bacteriologically and anatomically healed, and the patient allowed to return to society. Now that excision has made these foci available for pathological examination, such "radiologically inactive foci" have been found pathologically active and harboring viable bacilli. It is probable that these foci were responsible for the high rate of recurrence in the past. In this light, even though minor lesions remain, a patient anatomically divorced from such deceptive foci of disease stands a better chance today of escaping the hazard of recurrence.

It is essential, therefore, to know the life history of a particular patient's disease, as well as his current status, in order to decide upon an appropriate program of physical restoration. This is dovetailed with vocational evaluation and retraining at the proper time. Obviously, a minimal case responding readily to treatment will be handled more rapidly; while a long standing case with cavitation collapsed by thoracoplasty will need more cautious and slower upgrading. The patient's response to work can be assessed only in retrospect. Therefore, during the period of readaptation, serial clinical and x-ray and laboratory data must be constantly reviewed to detect any deviation from what is temporarily regarded as a stabilized condition.

In the consideration of work capacity the final problem has already been foreshadowed, namely, restoration to productive life. This, as we all know, offers a most difficult problem. It is true that not all patients can be so restituted; recurrences will take place. However, it is no overstatement that many who could have been successfully absorbed into normal community life did not complete their drama in this fashion. They were forced to seek, in desperation, work not medically feasible for them; in the end, the demands of the job exceeded the capacity of the patient and contributed to his breakdown. All previous excellent medical and surgical care was to no avail. This problem has a double facet: on one side, the responsibility of the hospital in offering suitable pre-vocational training; on the other, a community responsibility to absorb the former patients into its social and vocational life.

In the hospital, a dynamic program must be available which coordinates prevocational training with community resources of re-employment. This involves good vocational counseling and competent instruction. To this end, a patient may be prepared in a "family of trades" and later, after discharge, allowed to continue training with financial support of his family, if necessary. Thus, he compensates a reduced work capacity by a high quality of training and can therefore compete with his normal brothers. This procedure aims at the principle of *vocational acceptance* and requires a rehabilitation team for its achievement, both in the hospital and the community.

Without *social acceptance*, excellent training is useless. In the last analysis, the attainment of success in the overall management of tuberculosis is in the hands of the business world. Without a job, no man is completely restored

to society; but a pay envelope, or the equivalent, is the most potent proof of complete rehabilitation. But business continues to be timid about employing former patients. This reluctance stems mainly from the fear of financial liability under existing insurance laws for recurrence of the patient's illness. Again, we must look in the direction of social techniques for a solution. It is no fairer to hold employers responsible for an actual recurrence than it is to penalize by unemployment a former tuberculous patient who may have a recurrence. This problem has already been recognized in some state legislatures, and it is hoped that a clearing of the bottle neck in reemployment will result.

31st Annual Session

SCIENTIFIC EXHIBIT SPACE

Requests for applications for scientific exhibit space in connection with the 31st Annual Session to be held at The Palmer House, Chicago, August 31 through September 4, 1953, are being received. Address all communications to the American Congress of Physical Medicine and Rehabilitation, 30 North Michigan Avenue, Chicago 2, Illinois.

ARCHIVES of PHYSICAL MEDICINE and REHABILITATION

Official Publication
AMERICAN CONGRESS OF PHYSICAL MEDICINE AND REHABILITATION
AMERICAN SOCIETY OF PHYSICAL MEDICINE AND REHABILITATION

.·. EDITORIAL .·.

PHYSICAL MEDICINE AND REHABILITATION FOR MEDICAL STUDENTS

The facilities for physical medicine and rehabilitation available to civilian patients have expanded remarkably in the past ten years. Before that time small departments of physical therapy catering primarily to acute traumatic and orthopedic disabilities could be found in the better private and community hospitals. The treatment provided usually was incidental to other care, not supervised directly by the physician and terminated when the patient was able to get along at home without nursing care. Under exceptional circumstances certain physicians provided what might now be considered good physical medicine and rehabilitation, but the vast majority of physicians rarely used any physical therapy. The demonstration by the armed services that intensive physical medicine and rehabilitation was of tremendous value in restoring physically disabled personnel to active duty stimulated the development of rehabilitation in civilian medical practice. The Baruch Committee on Physical Medicine and Rehabilitation by its financial support of teaching and research programs, its collecting of statistics on needs for rehabilitation, and the publicity which it provided concerning this problem, helped to develop physical medicine and rehabilitation as a specialty. General publicity and the pressure of lay groups interested in rehabilitation for special types of disabilities have created a tremendous public demand at the present time for rehabilitation for all types of physical disabilities.

In view of this present demand for rehabilitation services, what is the professional situation with regard to physical medicine and rehabilitation today? The Veterans Administration and the military hospitals have well developed departments of physical medicine and rehabilitation. A few complete rehabilitation centers under the supervision of qualified physiatrists have been opened and more are planned in civilian hospitals. The number of residencies (87) available in forty-five hospitals approved for specialist training in physical medicine and rehabilitation is inadequate to meet the present demand for physiatrists. Thirty-seven medical schools now have departments of physical medicine and rehabilitation and sixteen others are planning to establish departments as soon as staff, space, or funds will permit.[1] Lack of qualified physiatrists available to head these new departments is one of the most important factors delaying their establishment. Physicians in general practice are now aware of physical medicine but are untrained to use it to the extent of their patients' needs. Medical students today graduate with

1. Elkins, E. C.: Educational Facilities in Physical Medicine and Rehabilitation, in 1950 Year Book of Physical Medicine and Rehabilitation, Chicago, Year Book Publishers, Inc., 1951, p. 9.

scarcely more knowledge of the prescription and application of physical medicine and rehabilitation than that of their predecessors ten or twenty years ago.

There are two serious causes for concern for the present status and future prospects of physical medicine and rehabilitation. The first and major cause for concern is the limited teaching of the principles and practice of this discipline in our medical schools. Only thirty-seven of our seventy-two medical schools in 1950 had established departments of physical medicine and rehabilitation.[1] Only forty-five medical schools had an undergraduate teaching program in physical medicine and rehabilitation. Ten of the accredited schools thought so little of the value of rehabilitation that they were uninterested in developing a department of physical medicine and rehabilitation. This means that in 1950 twenty-seven medical schools were, at the best, apathetic, or, at the worst, opposed to adapting the teaching program in medicine to the changing needs of the community. Demands for medical care in the United States are undergoing a marked change. The concept of adequate medical care is changing. It is no longer sufficient, medically, only to get the patient out of bed or to relieve his pain; rather, medical treatment should be aimed at restoring the patient in the shortest possible time to his social and vocational position in the community as a productive worker. The high cost of medical care today and the even higher cost of invalidism make rapid restoration to productive capacity imperative. Howard Rusk has aptly labeled this "the third phase of medicine."

The second cause for concern is that graduating medical students are not prepared to use physical medicine and rehabilitation as needed in the treatment of their patients. If physical medicine and rehabilitation is "the third phase of medicine" and restoration of the patient to functional independence is the goal of medicine, then the theory and application of physical medicine and rehabilitation should be taught in that relationship to all medical students. Actually physical medicine and rehabilitation is taught in most schools as a minor specialty to which the student is exposed. Integration of rehabilitation into general medicine and surgery and into the specialties is support verbally but in actual practice not enough time is devoted to the theory and techniques of rehabilitation to make the graduating medical student competent to use them.

There has been a tremendous increase in the demand for physical medicine and rehabilitation services with the relative and absolute increase in the importance of chronic diseases. It is estimated that at the present time twenty-six million people, one-sixth of the total population, have a chronic disease. One and one-half million people are disabled to the point of complete invalidism. Forty per cent of all services of a physician in home, office, and clinic are estimated to be for treatment of a chronic illness. Three of every four hospital patients in the United States are hospitalized for a chronic physical or mental disease. In the last fifty years life expectancy has increased from 49 years to 67 years. In 1900 there were thirteen adults under 65 years of age to each adult over 65. Today the ratio is 8:1. It is estimated that in another fifty years the ratio will be 4:1. This increased age of our population has increased the importance of chronic diseases and disabilities. When such a large proportion of medical care is consumed in the treatment of chronic disease it is time that all medical schools recognize it as an important factor when planning the curriculum. It is time, in the medical undergraduate curriculum that adequate emphasis be placed not only on the theory but also on practice of the techniques of physical medicine and rehabilitation.

It is obvious that the magnitude of the problem of caring for the chronically physically disabled can not be handled by the physiatrists alone. Evaluation of the problems of medical care among the chronically disabled shows that the majority of problems can be handled by the general physician if he has the proper training. Many of the chronically ill are geriatric patients who develop their disabilities gradually. A general physician, aware of these problems and the preventive measures available, can maintain his patients at a higher degree of self-sufficiency with less medical expense than is necessary with a more elaborate rehabilitation program after the patient is incapacitated. There is no question that the more difficult and involved problems require the skill of qualified specialists in fully equipped rehabilitation centers. The general physician does not have the experience, time, nor facilities to handle these cases. However, to insure that treatment is available to all patients, general physicians, as medical students, should be trained in the fundamental principles of physical medicine and rehabilitation. The team concept of medical care is nowhere so important as among physicians treating chronic disabilities. The family physician should be prepared by training to handle the ordinary problems requiring treatment by the techniques of physical medicine and rehabilitation. The physiatrists, as specialists, should be available to offer assistance in the treatment of the more difficult problems.

AMERICAN BOARD OF PHYSICAL MEDICINE AND REHABILITATION

The next examinations for the American Board of Physical Medicine and Rehabilitation will be held in New York, May 30 and 31, 1953. The final date for filing applications is March 31, 1953. Applications for eligibility to the examinations should be mailed to the Secretary, Dr. Robert L. Bennett, 30 North Michigan Avenue, Chicago 2, Illinois.

The American Board of Physical Medicine and Rehabilitation will permit applicants who have completed six units of credit to take Part I of the Board examination even though all or part of the six units were not obtained through approved residency training. Each year of residency training in programs approved for training in physical medicine and rehabilitation is equivalent to two units of credit. Each year of specialty practice, where the applicant can prove that he specialized in physical medicine and rehabilitation and is considered a specialist in this field by his colleagues, is equivalent to one unit of credit. After six years of practice with no formal training or by combining training units with practice units, an applicant may be eligible for Part I. It is suggested that those who are now in an approved residency training program wait until the end of such program before applying for Part I of the examination.

MEDICAL NEWS

Members are invited to send to this office items of news of general interest, for example, those relating to society activities, new hospitals, education etc. Programs should be received at least three weeks before the date of meeting.

Personals

Doctors **George M. Piersol** and **Igho H. Kornblueh** participated in the program of the section on medical history of the College of Physicians, Philadelphia, January 29. The subject was "Vanishing Springs and Health Resorts of Pennsylvania."

Edwin C. Welsh, M.D., Milwaukee, Wisconsin, has been appointed director, Department of Physical Medicine and Rehabilitation, Columbia Hospital. Dr. Welsh will continue his work at Marquette University School of Medicine and the VA Center, Wood, Wisconsin.

Doctors **Walter J. Lee** and **Rachel Weems** have left the Medical College of Virginia. Dr. Lee is now at the Acuff Clinic, Knoxville, Tenn. Dr. Weems is organizing a Department of Physical Medicine at the Rockingham Memorial Hospital, Harrisonburg, Va.

Dr. **R. Plato Schwartz,** Rochester, N. Y., is serving as a Fulbright lecturer on the subject of cerebral palsy in Denmark.

The following Congress members are also members of the newly formed International Committee on Spinal Paraplegia: Doctors **Arthur Abramson** of New York and **Albin T. Jousse** of Toronto, Canada. The committee has been established by the International Society for the Welfare of Cripples.

Dr. **Constantine G. Psaki** of Philadelphia recently presented a paper with slides and movies in January to the Alumnae Association of Physical Therapists, University of Pennsylvania. His subject was "The Diagnostic and Therapeutic Techniques Rendered by a Physical Therapist on a New Simplified Form in the Fulfillment of the Physiatrist's Prescription of Peripheral Vascular Diseases."

Louis B. Newman, M.D., Chicago, Ill., was an Officer of Instruction, Course in Internal Medicine, for the American College of Physicians in November. The subject of his lecture was "Physical Medicine and Rehabilitation in the Management of Rheumatoid Arthritis."

At the January 15 meeting of the Pennsylvania Academy of Physical Medicine and Rehabilitation, Doctors **Charles A. Furey, Jr.,** and **William H. Schmidt** presented the topic entitled, "Recent Trends in the Treatment of the Paraplegic Patient."

Peter A. Volpe, formerly of Aspinwall, Pa., is now Manager, Hines VA Hospital, Hines, Ill.

Jessie Wright, Pittsburgh, Pa., was 1 of 10 women selected as Pennsylvania's 1952 Distinguished Daughters.

Robert Stecher, Cleveland, Ohio, has been elected Secretary-Treasurer of The Friends of the Armed Forces Medical Library, Washington, D. C.

Physical Medicine and Rehabilitation Fellowships

Postdoctoral clinical fellowships in Physical Medicine and Rehabilitation are being offered by The National Foundation for Infantile Paralysis. The fellowships cover periods of 1 to 3 years, stipends being based on individual needs. Requirements for eligibility include United States citizenship, graduation from an approved medical school, completion of at least a one year internship in an approved hospital, and a license to practice medicine. Age limit is 40 years. The Foundation is also making available short-term fellowships to physicians who wish to become better acquainted with the specialty. Additional information can be obtained by writing to the Division of Professional Education, National Foundation for Infantile Paralysis, 120 Broadway, New York 5.

Peter F. Amoroso

It is with deep regret that we announce the death of Dr. Peter F. Amoroso, New York, N. Y., on December 27, 1952.

Dr. Amoroso was a Congress member for many years.

Production of Gamma Globulin to Be Financed by Red Cross

The American Red Cross has decided to finance the production of all possible gamma globulin, which has brought several changes in the National Blood Program. It is noted that even with a 7-day week and 24-hour day processing schedule, the supply of gamma globulin will not meet the demands at the height of the polio season next summer. The blood fraction is now recognized as effective in preventing paralysis in polio victims. The supply of gamma globulin will be furnished without charge to whatever distribution agency is selected.

Rehabilitation Seminars

The Children's Division of the Institute of Physical Medicine and Rehabilitation, New York University-Bellevue Medical Center held a series of seminars in the rehabilitation of children, January 18-22, 1953. Dr. George Deaver, a member of the Congress, supervised the course. Tuition is $40 and is open to all physicians. For additional information, write to New York University Post-Graduate Medical School, 477 First Ave., New York 16, N. Y.

Chicago Society Meeting

The Chicago Society of Physical Medicine and Rehabilitation held its February meeting on Wednesday, February 25. After dinner, a scientific session was presented at Loyola University School of Medicine. Dr. Arthur Steinhaus delivered the talk entitled "Some Physiological Effects of the Cold Hip Bath."

Research Grant

The Multiple Sclerosis Foundation has presented to Northwestern University Medical School a check for $25,000 for research in multiple sclerosis.

New York Society of Physical Medicine

The following officers have been elected by the New York Society of Physical Medicine for 1953: Hans J. Behrend, President; Morton Hoberman, Vice-President; Jerome Weiss, Treasurer and Madge C. L. McGuinness, Secretary. The Executive Committee consists of the following: Sidney Licht, Chairman; Arthur S. Abramson; Nila K. Covalt; William Bierman and Hans Kraus. The Nominating Committee consists of Sidney Licht, Chairman; Elemer J. Marjey and Samuel S. Sverdlik.

New England Society of Physical Medicine

At the January 21, 1953, meeting of the New England Society of Physical Medicine, a Symposium on Arthritis was held. Dr. Arthur L. Watkins of Boston was one of the collaborators.

Institute of Restorative Medicine

The department of psychiatry and neurology of Baylor University College of Medicine recently opened The Institute of Restorative Medicine at Jefferson Davis Hospital, Houston, Texas. Dr. **Ben L. Boynton,** Professor of Physical Medicine and Rehabilitation at Baylor, states that patients are under study to determine the feasibility of rehabilitation in their cases. The aim of the new unit is to restore the patient to a productive place in society.

Fellowships for Specialized Training for Counselors

Alpha Gamma Delta International Women's Fraternity and the National Society for Crippled Children and Adults each year grant awards covering tuition and maintenance to qualified counselors, guidance teachers and other professional persons working with young people at the high school and college levels who are crippled or are physically impaired. This training will be given at the Institute of Rehabilitation and Physical Medicine of the New York University-Bellevue Medical Center from June 22 to July 17, 1953.

Applications may be secured from the National Personnel Registry and Employment Service of the National Society for Crippled Children and Adults, 11 South La Salle Street, Chicago 3.

Cleveland Society of Physical Medicine and Rehabilitation

At the March 26, 1953, meeting of the Cleveland Society of Physical Medicine and Rehabilitation, Dr. Donald L. Rose of Kansas City, Kansas, will present the topic "Backache." The meeting will be preceded by dinner at 6:00 P. M.

Physical Therapy Group to Meet

The 30th annual conference of the American Physical Therapy Association will be held at the Baker Hotel, Dallas, Texas, June 15-19. The theme for the program will be the "Patient — His Evaluation and Program for Rehabilitation."

Newly Registered Therapists

December 26, 1952

Bell, Norma Jane, Rt. 3, Circleville, Ohio.

Cleffi, Marilyn E., 48 W. Blackwell St., Dover, N. J.

Freehling, Mary Louise, Marwood, Pa.

Gourley, Robert Strong, 1231 Brown Ave., Erie, Pa.

Hoch, Madeleine Synyer, 132 Overbrook Rd., Elyria, Ohio.

Holman, Margaret Ann, 2242 E. Brill, Phoenix, Ariz.

Kelley, William Joseph, 40 Franklin St., Arlington 74, Mass.

McBane, Elizabeth Ann, 1158 Cleveland St., Salem, Ohio.

Meyers, Marion JoAnn, 917 Lina St., Johnstown, Pa.

Murphy, Elizabeth V. E., 1506 Euclid Ave., Boise, Idaho.

Nakasone, Yuki, 337-D, Kihapai St., Lanikai, Oahu, T. H.

Nebera, John, Box 79, Rt. 3, Fairview, West Va.

Riley, Emilie Christine, 15 S. 6th St., Shamokin, Pa.

Roberts, Janice May, 3904 Cherry St., Erie, Pa.

Spring, Antoinette, 2756 Landon Rd., Shaker Heights, Ohio.

Ulrich, Betty Louise, 14 Thatcher Ave., Buffalo, N. Y.

January 20, 1953

Andersen, Frances Marie, 1713 Sanford Pl., Escondido, Calif.

Boysen, Robert Matt, 558 S. Palm, Anaheim, Calif.

Branch, Cora Jean, 42 Sullivan, Forty Fort, Pa.

Burton, Betty, 2565 Tyler Ave., Ogden, Utah.

Coon, Lorraine S., 464 Sawyer St., New Bedford, Mass.

Dove, Barbara Marie, 704 6th St., Ludington, Mich.

Ellingboe, Anna Roselyn, Box 884, Port Orchard, Wash.

Gent, John, Jr., 1226 W. 37th Pl., Los Angeles 7, Calif.

Gschwind, Vilas Marie, 7448 Jordan Ave., Canoga Park, Calif.

Hamasaki, Miriam Kimie, 2504 Main St., Wailuku, Maui, T. H.

Holthouse, Richard Bruce, 1184 W. 39th St., Los Angeles, Calif.

Kamm, Donald Eugene, 63 Radio St., Rochester 5, N. Y.

Kiaunis, Theresa C., 1454 Byron, S. E., Grand Rapids, Mich.

Kuckhoff, F. Albert, 5206 Cuthbert Ave., Pimlico, Md.

Ledford, Catherine Howard, 265 Plymouth Dr., Pasadena 6, Calif.

Leonhardt, William Paul, Y. M. C. A. Camp, Palos Hills, Orland Park, Ill.

Lyons, Catherine Margaret, 3128 42nd Ave. So., Minneapolis, Minn.

McKenney, Ann Cecelia, 99 Walter St., Roslindale, Mass.

Midgley, Geraldine, 47 S. 3rd East, Salt Lake City, Utah.

Ohliger, Joyce, 595 Hayne Rd., San Mateo, Calif.

Pfaffenberger, Elmer Irwin, 506 F St., Antioch, Calif.

Rubel, Rosella Mary, Madelia, Minn.

Schneider, Robert Jerome, Sheridan, Mont.

Sorenson, Lois May, 411 W. Faribault St., Duluth, Minn.

Varelia, Helen Louise, 926 S. Clela, Los Angeles 22, Calif.

Wendkos, Stanley Leonard, 5451 Claridge St., Philadelphia, Pa.

Wood, Martin Lane, 1116 Alice St., Modesto, Calif.

Ylvisaker, Paul Donald, 2209 23rd St., Everett, Wash.

BOOK REVIEWS

The reviews here published have been prepared by competent authorities and do not necessarily represent the opinions of the American Congress of Physical Medicine and Rehabilitation and/or The American Society of Physical Medicine and Rehabilitation.

SYMPOSIUM ON RADIOBIOLOGY, THE BASIC ASPECTS OF RADIATION EFFECTS ON LIVING SYSTEMS. Oberlin College, June 14-18, 1950. Edited by *James J. Nickson*, M.D. Editorial Committee: P. Morrison, M. Burton, E. S. Guzman Barron, C. Iailla, H. M. Patt. Sponsored by the National Research Council of the National Academy of Sciences. Cloth. Price, $7.50. Pp. 465, with illustrations. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, 1952.

The subcommittee on Radiobiology of the Committee on Nuclear Science of the National Research Council recommended that a symposium be held on the basic aspects of the radiation effects on living cells. This volume reports the papers and discussions presented at the Oberlin Symposium on Radiobiology in June, 1950. As in all such meetings the editor in charge has the difficult task of assembling the material, and many factors step in to delay publication. However, the work has lost nothing by the regrettable delay, and Doctor Nickson and his coworkers are to be congratulated for a task well done.

The objective of the meeting was to undertake a thorough examination of the fundamental concepts that exist in radiobiology. Since the interaction of ionizing radiation in living matter should be considered in as orderly a manner as possible, it was decided that the subdivisions and their order would be essentially as follows: First, a survey of the physical interaction of ionizing radiation and matter; second, a discussion and elucidation of the chemical changes arising from the transfer of this physical energy; third, an examination of the biochemical effects; and, finally, a discussion of the changes occurring in living tissue. With the material presented in this fashion it was felt that avenues to the solution of existing problems might be pointed up and hiatuses in present knowledge would be more clearly delineated. The objectives were fundamental concepts and ideas rather than isolated information and these objectives have been reached to a remarkable degree.

This unusually splendid presentation will not interest the medical practitioner unless he happens to have a particular interest in this expanding and fundamental discipline. There is some mathematical knowledge required and necessarily so for a full understanding of the text which, many would feel to be a handicap.

REVIEW OF PHYSIOLOGICAL CHEMISTRY. By *Harold A. Harper*, Ph.D., Professor of Biology (Biochemistry), University of San Francisco, San Francisco. Third Edition. Paper, Loose-leaf. Price, $3.50. Pp. 260, with 13 illustrations. University Medical Publishers, P. O. Box 761, Palo Alto, California, 1951.

The Review of Physiological Chemistry by Doctor Harper is a most useful manual. That it is meeting a need is evident from the fact it is now in its third edition. The author presents the fundamentals of physiological chemistry with emphasis on the accepted facts and concepts of the subject. The author states he has left the theoretical and controversial principles to the usual texts and current reviews.

The purpose of this review is first to supplement the standard texts in biochemistry for the student undertaking these courses, and second, to serve as a review for the physician preparing for state and specialty boards. It should also prove of great value to those physicians who wish to keep abreast in this rapidly expanding branch of medical science. There are sixteen chapters. The text is unusually well illustrated. For further study an excellent list of books, reviews and journals are given. There is an adequate index. The volume is bound in a stiff paper cover and the print is planographed but is clear and easily read.

MEDICAL MILESTONES. By *Henry J. L. Marriott*, M.D., Assistant Professor of Medicine, University of Maryland School of Medicine. Foreword by *Sir Alexander Fleming*. Cloth. Price, $3.50. Pp. 305, with 6 illustrations. The Williams & Wilkins Company, Mt. Royal and Guilford Aves., Baltimore 2, 1952.

The author states he had two purposes in mind in writing this book. First, it was his intention to collect in one volume the major medical advances of a unique period and present them in readable form. Doctor Marriott's second aim was to make the account authoritative and balanced. Both of these objectives have been splendidly achieved. It is a book written for the non-medical public and it is the author's view that they have the right to know the truth about what the advancing profession has achieved on their behalf, and on behalf of their children. Doctor Marriott without sacrificing fact to entertainment or drama

has presented the truth about medical progress as he sees it. Most, if not all, of the developments referred to have already been served up for lay consumption. Unfortunately, however, the form in which they have been presented has often been too appetizing; some highly readable accounts have been overly enthusiastic and occasionally even hysterical.

Several chapters are given to the story of the antibiotics. Chapters are devoted to new treatments for anemia; blue babies to pink; blood anticoagulants; hormones and cancer, the Rh story; if anyone touches a leper; and hope for the rheumatic. There are twenty chapters in all. A foreword is written by Sir Alexander Fleming, a former professor of the author. Each chapter is written in a clear, concise and interesting manner. Such a book will undoubtedly be greatly appreciated by the non-medical reader. It is to be hoped that physicians will make a real effort to recommend this volume to their patients. It is most highly recommended.

CLINICAL APPLICATIONS OF RECREATIONAL THERAPY. By *John Eisele Davis,* Sc.D., Chief, Corrective Therapy, The Veterans Administration, Washington, D. C. Leatherette Binding. Price, $3.75. Pp. 118, with illustrations. Charles C Thomas, Publisher, 301-327 East Lawrence Avenue, Springfield, Ill., 1952.

This monograph, written by a physical educator, consists of 42 brief chapters. Some of the therapeutic possibilities of planned and directed recreational activities for psychiatric patients are given. It is pointed out that most of the exploratory work is yet to be done in this field. Although the term "recreational therapist" is used throughout the monograph, the author states that at the present time the "recreational therapist" has no specific or recognized training. Suggestions are made regarding the advisability of orientation lectures in psychiatry in addition to experience in mental hospitals. Possible therapeutic applications of selected recreational activities to various psychiatric conditions are presented and illustrated by brief case histories. Many quotations and references are used to support the author's concepts of the value of recreation as a form of therapy. The relationship of occupational therapy to recreation as part of the therapy program is not defined or made clear. It is emphasized that there should be a place for graduates from schools of physical education who have certain suitable personality attributes and who have taken certain orientation courses to qualify them for useful employment in recreational work in mental hospitals. This monograph will be of general interest to psychiatrists and physiatrists as it indicates some of the potentialities of one of the adjunctive forms of treatment of psychiatric patients. It will be of interest to occupational therapists in indicating possible wider uses of the recreational phases of occupational therapy.

COWDRY'S PROBLEMS OF AGEING; BIOLOGICAL AND MEDICAL ASPECTS. Edited by *Albert I. Lansing,* Ph.D., Washington University, St. Louis. Third Edition. Forty-eight Contributors. Cloth. Price, $15.00. Pp. 1061, with illustrations. The Williams & Wilkins Co., Mt. Royal and Guilford Aves., Baltimore 2, 1952.

This large and authoritative textbook covers in a very thorough manner practically all problems of ageing. It is divided into three sections. Section I deals with biological and cellular problems of ageing, Section II deals with clinical and organic problems of ageing, and Section III deals with social and economic problems of ageing. There are no less than forty-seven contributors, all outstanding scientists, and there are forty chapters, covering a variety of subjects too numerous to list in this review.

Because of the fact that the population of the United States is ageing rapidly and thus geriatric problems are coming more and more to the fore, this outstanding textbook on the problems of ageing will be of particular interest to every physiatrist and should indeed be of interest to every physician who has elderly persons among his patients. It is becoming increasingly apparent that the physician who specializes in physical medicine and rehabilitation can play a major role in the care of ageing patients, and physiatrists will be particularly interested in the chapter on "Rehabilitation for the chronically ill and aged," by Howard A. Rusk and Eugene J. Taylor.

This book is highly recommended as perhaps the most complete and authoritative volume ever published concerning the biological and medical aspects of ageing.

MEDICAL BIOGRAPHIES. The Ailments of Thirty-Three Famous Persons. By *Philip Marshall Dale,* M.D. Cloth. Price, $4.00. Pp. 259, with illustrations. The University of Oklahoma Press, Norman, Oklahoma, 1952.

This is a delightful and entertaining book which combines with unusual success biography and medical science. Dr. Dale's entertaining style and facility with words makes the book fascinating reading from beginning to end. It is a lively book which should interest any physician who enjoys biography, because the medical aspects of each famous person's life are discussed in detail and conclusions are drawn concerning the illnesses of each in the light of present-day medical knowledge. These medical biographies of various famous persons are described in chronological order, which adds to the interest of the volume.

Starting with Buddha, Dr. Dale presents successively the medical problems which Buddha encountered and then he writes bright, quick sketches of the lives of Charlemagne, William the Conqueror, Christopher Columbus, Henry VIII, Benvenuto Cellini, Philip II, Samuel Pepys, Sir Isaac Newton, Dean Swift, Peter the Great, Frederick the Great, Immanuel Kant, Catherine

the Great, George Washington, Edward Gibbon, George III, Jean Paul Marat, John Paul Jones, Andrew Jackson, Napoleon Bonaparte, Nancy Hanks Lincoln, Lord Byron, John Keats, Edgar Allan Poe, Charles Darwin, Walt Whitman, Frederick III of Prussia, James A. Garfield, Grover Cleveland, William McKinley, Guy de Maupassant and Robert Louis Stevenson. Photographs of all of these famous persons are included, with the exception of Nancy Hanks Lincoln of whom no known likeness exists.

This book can be read in snatches because each of the medical biographies is a story in itself. However, the book is so delightfully interesting that the reader will find it very difficult to put it down once he has started reading it. The book will undoubtedly be enjoyed by many physicians and it should be an ideal gift for any physician who likes biography.

THE CARE OF THE AGEING AND CHRONIC SICK. By *A. P. Thomson,* M.C., M.D., Ch.B. (Birmingham), F.R.C.P. (London), Dean of the Faculty of Medicine and Professor Therapeutics, University of Birmingham; Consultant Physician to the United Birmingham Hospitals; Chairman of the Planning Committee of the Birmingham Regional Hospital Board; *C. R. Lowe,* M.D., Ch.B. (Birmingham), M.R.C.S. (England), L. R. C. P. (London), D.P.H., Lecturer in Public Health, Department of Social Medicine, University of Birmingham; *Thomas McKeown,* B.A. (British Columbia), Ph.D. (McGill), D.Phil. (Oxford), M.D. (Birmingham), M.B., B. S. (London), Professor of Social Medicine, University of Birmingham; Member of the Birmingham Regional Hospital Board. Paper. Price, $1.50. Pp. 133. The Williams & Wilkins Company, Mt. Royal and Guilford Aves., Baltimore 2, 1951.

This interesting monograph is divided into two sections, one on problems of ageing and chronic sickness by Prof. A. P. Thomson and the other on the care of chronic sick by Dr. C. R. Lowe and Prof. Thomas McKeown. The second section discusses medical and nursing requirements, social and demographic data and gives surveys and comparisons of aged and chronically ill patients in various centers in Birmingham. The conclusion made by Professor Thomson is interesting. He stated: "My purpose when I set out on this inquiry was simply the discharge of what seemed a disagreeable duty — the discovery of the best means of improving the state of the institutions for the aged and chronic sick in the Birmingham region. I now believe that the problem is one which intimately concerns the whole of clinical medicine and yet has been almost entirely neglected." It is believed that most readers will agree with this conclusion. This monograph will be of interest to any physician concerned with the problems of treating aged persons.

BODY DYNAMICS. By *Eleanor Metheny,* Ph.D., Professor of Education and Physical Education, University of Southern California. McGraw-Hill Series in Health Education, Physical Education and Recreation. *Clifford Lee Brownell,* Consulting Editor. First Edition. Cloth. Price, $3.50. Pp. 225, with 55 illustrations. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, 1952.

A great deal has been written on human fitness for those working professionally but little has been written for the general reader. This book is written primarily for the general reader who is interested in improving his own physical efficiency. It deals with the problems of fitness in terms of the efficient expenditure of human energy to produce maximum results with minimum effort. Sound information about the functioning of the human body is given in simple nontechnical language. Ways in which the physical condition of the body may be improved by appropriate exercise are described and modern principles of posture, movement, and relaxation for efficiency in work and play is discussed. The author holds, first, that the fundamental principles for the efficient functioning of the human body can be taught simply to intelligent persons who have no scientific knowledge of anatomy and physiology, and second, that an understanding of these principles can motivate action which results in improved physical efficiency.

The presentation by Doctor Metheny is very simple, clear and written in good concise language. The book should find a ready welcome for those for whom the volume is intended. The contents are presented in four sections. There are two introductory chapters in part one, one dealing with a preview of the subject matter and the second with basic structures and functions of the body. Part two discusses the expenditure of energy. Part three deals with the conservation of energy. Part four is an appendix of suggested exercises with a well chosen group of books to which the reader may refer for further study. This is a well balanced and sensible book which is highly recommended.

TUBERCULOSIS OF BONE AND JOINT. By *G. R. Girdlestone,* Sometime Nuffield Professor of Orthopaedic Surgery in the University of Oxford and *E. W. Somerville,* M.B., F.R.C.S. (Ed.), Orthopaedic Surgeon to the Wingfield-Morris Orthopaedic Hospital, Oxford, from the Nuffield Orthopaedic Centre. Second edition. Cloth. Price, $8.75. Pp. 314, with illustrations. Oxford University Press, 114 Fifth Avenue, New York 11, 1952.

In re-emphasizing "the old and well-tried surgical principles" in the treatment of bone and joint tuberculosis, the authors have succeeded in making their second edition most timely and valuable. Their extensive experience with this disease permits them to speak with authority. Their presentation is orderly, clear and quite readable; the material quite comprehensive. Classical ro-

entgenograms illustrate the lesions under discussion. The tabulated statistics are very enlightening.

The opening chapters deal with fundamental concepts of the disease, the art and science of establishing the diagnosis, and the aims and methods used in both the general and the local treatment of the disease. The role of antibiotics and chemotherapeutic agents is discussed briefly. Suggested dosages are given. The major portion of the text pertains to specific joint involvement. The pathology, diagnosis, operative and nonoperative treatment, with management of complications, are outlined. In the discussion of Pott's Paraplegia a justifiable plea is entered for a reevaluation of conservatism in treating this complication. Timely definitive treatment appears rational after reading this section. The chapter on the management of the "problem patient" with combined skeletal and pulmonary lesions is most interesting and informative. An appendix of splints and appliances found useful by the authors is presented.

CLINICAL LABORATORY DIAGNOSIS. By *Samuel A. Levinson,* M.S., M.D., Ph.D., Director of Laboratories, University of Illinois Research and Educational Hospitals, Chicago, Illinois; Professor of Pathology, University of Illinois, College of Medicine and *Robert P. MacFate,* Ch.E., M.S., Ph.D. Chief, Bureau of Laboratories, Department of Health, City of Chicago; Assistant Professor of Pathology, University of Illinois College of Medicine; Formerly Assistant Director of Laboratories, University of Illinois Research and Educational Hospitals, Chicago, Illinois. Fourth edition, thoroughly revised. Cloth. Price, $12.00. Pp. 1146, with 221 illustrations and 13 plates, 10 in color. Lea & Febiger, 600 S. Washington Sq., Philadelphia 6, 1951.

Since this book was first published in 1937, a great many advances have been made in clinical pathology. In attempting to keep abreast of progress in this field, important changes have been made in this edition. In an effort to reduce bulk, an outline form is utilized throughout the book. While this does not make for a smoothly reading text, it does enable the authors to include a tremendous amount of material. It is remarkable how each chapter manages to represent a complete survey of the subject without being an exhaustive and exhausting treatise on the subject. As stated in the authors' preface, the object of the book aims to present to the student, interne, resident physician, practicing physician, and medical technologist a suitable review of laboratory procedures, sufficient to meet their general needs. This has resulted in a very clear and comprehensive presentation of the greater part of our technical knowledge in the field of laboratory medicine. It is an excellent laboratory manual and reference work for all the groups of people for whom it was intended.

In general the material is quite up to date, although the modern importance of the "formol-gel test" is such as hardly to justify its inclusion in a book of this type. Methods of determining blood glucose do not include the more satisfactory Somogyi-Nelson technique, but confine themselves to various modifications of Benedict's. On the other hand the completeness of the section on chemistry of the blood is illustrated by the fact that excellent procedures for protein-bound iodine and magnesium are included. The section on urine and kidney function tests is very well done and includes one of the few descriptions of the technique for insulin clearance occurring in any laboratory manual of this type. It does not discuss at any length the urine concentration tests, which seem to the reviewer to be of more importance than other subjects treated more completely. The section on hematology is more than adequate and takes up approximately one-fifth of the pages of the book. It is unfortunate that the color plates do not show up as well in the textbook as they did in the original movies from which they were taken. The sections on bacteriology, serology, and parasitology are well done, and there is an extensive discussion of antibiotics, which is all too often overlooked in a book of this type.

Probably the best written chapter of the book is the one entitled laboratory methods in pediatric procedures. This is exceptionally well written and should be a great help to people who are interested in this field. The tables of normal values are particularly useful. The section on tropical diseases is of necessity sketchy, but would prove useful as a starting point in the investigation of many of these diseases. Legal medicine and toxicology are discussed in a manner that is more than adequate for the average clinical laboratory. Many textbooks on this subject are no more adequate than this section is. It is unfortunate that a bibliography is not included or that some more adequate form of footnote references is not utilized. On the whole it can be considered one of the better handbooks of clinical pathology today and should be considered as a very useful laboratory tool.

PHYSICAL MEDICINE ABSTRACTS

Hydrogymnastics — How Good? C. L. Lowman.
Hosp. Management 73:138 (Jan.) 1952.

The therapeutic use of pools is recorded in the Bible, and yet today there are more emphatic endorsements to this ancient technique than ever before in medical history. At the recently concluded Second International Congress on Poliomyelitis which was held in Copenhagen, Denmark, quickened interest was shown in hydrogymnastics for many types of distressing conditions, such as flaccid and spastic paralysis, joint and postsurgical conditions, and of course, most notably the disabilities resulting from poliomyelitis. Today there are approximately 125 exercises for muscle re-education which are possible in water and which are impossible anywhere else. There are five principal reasons for the ever-increasing acceptance of the hydrogymnastic treatment: (1) There is greater ease and movement of body parts in water, because of natural laws which govern buoyancy and viscosity. The improved ease of movement is especially valuable in painful and neuritic conditions, as in the subacute stage of poliomyelitis; (2) the treatment is excellent in postoperative cases where plastic joint surgery or tendon transplantation has been done; (3) the use of therapeutic pools usually brings out the maximum degree of enjoyment and personal interest on the part of the patient; (4) the hydropathic effect on nervous and circulatory systems throughout the skin is of definite value; and (5) the improved morale on the part of the patient is beneficial, both psychologically and physiologically. Hydrogymnastic treatment is not "swimming," nor is it simple. If the average swimming instructor, without thorough and intensive training in anatomy, normal and abnormal kinesiology and other such allied sciences attempted to take paralysis cases into the water, there is every possibility that he would do more harm than good.

Of the various types of work in connection with the treatment, none is sufficiently simple to be handled by untrained personnel. Work on the submerged plinth is one subdivision in the application of this modality, while free-floating work is another. Working with some form of partial fixation for stabilizing either the shoulder girdle or the legs and pelvic girdle is still another form. Generally speaking, the plinth work follows very closely the muscular re-education work done out of the pool. In the free-floating movement, any exercise without assistance is made against resistance of the water, either on the surface or submerged. Floating with assistance seems indicated for very weak or new cases who need support, either physical or psychological. The value of resistive exercises has long been recognized by physicians, and there is no type of such therapy in which the resistance factor is as uniform as that of water. To overcome buoyancy requires a certain effort. If a technician applies resistive exercise skillfully, work can be localized to definite sets of muscles. If the resistance should be increased, hand paddles for the arms or wooden splints for the legs may be used to supply added surface to the resistance of the water. Thus it can be seen that proper hydrogymnastic treatment is far from a simple swimming lesson, and that technicians need many qualifications. A simple knowledge of kinetics is not by any means sufficient to qualify a technician. Hydrogymnastic treatment now seems firmly established in medical practice for the relief of pain and suffering. The author feels that it can be more useful, in a general sense, than any other modality in physical therapy.

Effects of Ultrasonic Therapy on Rheumatic Diseases and Circulatory Disorders. Fritz Tschannen.

Brit. J. Phys. Med. 15:7 (Jan.) 1952.

Certain forms of rheumatic disease have crystallized up to the present as the main indication for ultrasonic therapy. These are, in particular, the degenerative forms: osteoarthrosis (osteoarthritis), chondrosis and spondylosis. In inflammatory forms, as, for example in rheumatoid arthritis, no success other than a transitory analgesic effect is obtained by ultrasonic treatment. A single exception is formed by Bechterew's disease (rheumatoid spondylitis), in which quite satisfactory results can be achieved, provided that complete ankylosis is not present. In spite of the small number of years which have passed since its introduction, this method of treatment has attracted a number of adherents in various countries. Under the influence of radicular ultrasonic therapy — that is to say, its application to the nerve-segment with which the affected limb is associated — there occurs a significant degree of loosening, relaxation of tension and improved circulation in the affected extremity. The relaxation of muscle spasm leads to relief of pain, and this, in turn, to decrease in hypersensitivity of the related motor and sympathetic nerve-segments. Thus the vicious circle — irritation, hypersensitivity of nerve centers, muscular and vascular spasm, irritation — is interrupted at some point. Provided that the vascular system, particularly the capillary network, is still reacting elastically, the improved circulation in the periarticular tissues leads to regenerative processes in the joint. In addition to the principal field of indication — that of the degenerative joint disorders — excellent results are seen in muscular rheumatism, lumbago, torticollis and muscular spasticity of the shoulder-girdle, which often is still called plexus neuralgia.

The Treatment of Recent Transcervical Fractures of Femur. D. O. Williams, and E. K. McLean.

Brit. M. J. 1:580 (Mar. 15) 1952.

This is a report of a simple method of treating adduction fractures of the femoral neck and also abduction fractures which have disimpacted. The results appear to be satisfactory according to modern standards. Bone grafting was not carried out in any case.

Following operation, various methods of restricting external rotation of the injured limb were tried and discarded. As a routine measure the authors now use the abduction frame designed by McLean (1949). This frame prevents external rotation and adduction of the limb while permitting flexion and extension of the knee- and hip-joints. It also acts as a bed-cradle, thus relieving the legs of the weight of the bed clothes.

The day after operation active exercises under the direction of a physical therapist are begun, all movements of the hip, knee, and ankle being permitted except external rotation and adduction of the hip-joint.

At the end of one month a radiograph of the injured hip is taken, and if the position of the nail and of the bony fragments has been maintained the patient is allowed up daily for non-weight-bearing exercises on crutches. Further x-ray films are taken at intervals of a month, and, provided there is radiological evidence of bony union, graduated weight-bearing exercises are begun at the end of three months. If union has not occurred, or its degree is doubtful, weight-bearing is postponed until it is definitely present; this may mean a delay of six months or more in some cases.

Provided home conditions are satisfactory and the general condition is good, the patient is discharged from the hospital when he has learned to manage crutches. Most of patients included in this report remained in hospital for the full three months, principally because they lived alone.

Some Problems of Bronchial Asthma. H. Herxheimer.

Brit. J. Phys. Med. 15:129 (June) 1952.

Herxheimer questions whether breathing exercises, ordered so generally and carried out for a long time, have improved the results in the treatment of asthma. As is well known, many methods of treatment relieve the disorder in a high percentage of cases; the common explanation of this fact is that psychological factors support their effect. It may be taken for granted that certain favorable psychological factors will accompany breathing exercises, as they do other methods; the patient is actively doing something to treat his disease, and the confidence of his physician, of the physical therapist and of himself are strong factors of great value.

Leaving this part of their action aside, it should be determined whether or not breathing exercises can facilitate the passage of air into and out of the lungs in spite of given obstacles. The air is transported by the movemnet of the respiratory and diaphragmatic muscles, the elasticity of the lungs and the weight of the thorax. The muscles may be subject to the influence of exercise, but the question is: can they be trained to overcome obstruction and, if so, in what circumstances?

In the experience of Herxheimer, patients with mild or moderate attacks of asthma and long free intervals have a large vital capacity, often larger than the expected value. Naturally, such patients exert themselves greatly during their attacks and practice inspiration and expiration with maximal effort. It is unlikely that the efficiency of their respiratory muscles could be improved still further by breathing exercises. It may be possible to teach such patients not to be frightened by their attacks, and to use their abdominal muscles in a determined effort to prevent over-inflation, but it is doubtful that such an attempt would be of value in an acute and violent attack.

In chronic asthma the position may be different. Here we see patients with mild bronchial obstruction, whose chests seem to be more inflated than is warranted by the degree of obstruction. If these patients are treated with drugs which relieve obstruction, the inflation seldom recedes at once. The vital capacity improves only by a few hundred millilitres after each treatment, and it takes several days or more to reach a normal state of ventilation. Wyss and Schmid (1951) have measured the bronchial resistance in asthmatic cases and found that in some cases it was much smaller than was expected. They conclude that in these cases the breathing difficulty must have been caused by "increased tonus" of the respiratory muscles and the diaphragm. It may be assumed that in such cases breathing exercises can be of great value, if they lead to a general relaxation of the musculature and thus to a deflation of the thorax.

Physical Medicine Plus Cortisone for Rheumatoid Arthritis. Gordon M. Martin; Howard F. Polley, and Thomas P. Anderson.

J. A. M. A. 148:525 (Feb. 16) 1952.

Because of the recent interest in cortisone and corticotropin (ACTH) in the treatment of rheumatoid arthritis, physical medicine and other measures that are of proved value in the management of patients with rheumatoid arthritis have been slighted. The purpose of this study is to evaluate the relation of physical medicine to cortisone in the treatment of such patients. As the treatment with cortisone of increasing numbers of patients having rheumatoid arthritis has continued, it has become apparent that cortisone alone, as it is customarily used at present, does not always provide complete control of the disease. It is well recognized, as has been reported, that cortisone alone will relieve much of the pain and stiffness and will produce a decrease in the synovial inflammatory reaction. However, in order for many patients with rheumatoid arthritis to obtain maximal objective signs of improvement in articular function while receiving safe suppressive doses of cortisone, it is essential to utilize a program of treatment that includes physical medicine. Two groups of patients hospitalized for rheumatoid

arthritis were used in this study. One group received conservative treatment including physical medicine, adequate rest, salicylates, proper diet and, in some instances, special articular supports when indicated. The other group received similar conservative measures plus cortisone. The physical medicine program consisted essentially of daily systematic heating for thirty minutes accomplished by the application of luminous infra-red bakers, by means of a hot tub bath with a water temperature of 102 to 104 F. or by a hot moist-air "fever cabinet," the latter two methods raising the patient's oral temperature to 100 to 101 F. The application of heat was followed by light to deep stroking and kneading massage of the affected extremities. The exercise program consisted of active and assistive exercise to attempt to increase the range of motion. When indicated, resistive exercises were prescribed to increase strength of muscles. Gait training made up an essential part of the exercise program of many of the patients, some of whom were taught to eliminate a limp, others how to get in and out of chairs, how to use crutches or canes properly, and how to determine the amount of walking or other activity that could be tolerated. Eighty per cent of the group of 34 patients with moderate to severe rheumatoid arthritis treated with physical medicine and other conservative measures showed objective evidence of improvement in articular function and ambulation. Eighty-five per cent of the similar group of 54 patients who were treated with cortisone in addition to physical medicine and other conservative measures showed objectively improved articular function. Patients with rheumatoid arthritis who have limitation of articular function and who are receiving cortisone may benefit further by a carefully prescribed and supervised program of physical medicine. However, the physical medicine program must be carefully prescribed for each patient. Exercise tolerances vary widely, and the ability to progress from active assistive exercise to resistive exercise and increased ambulation needs to be carefully determined and regularly supervisd.

Ultrasonic Wave Therapy in Osteoarthritis of the Hip Joint. Theo D. Preux.

Brit. J. Phys. Med. **15**:14 (Jan.) 1952.

Evidently ultrasonic therapy does not solve the problem of osteoarthritis of the hip joint. Its value will be limited in advanced cases with destruction, severe mechanical and static impairments. But for the great majority of cases of osteoarthritis at their onset, and many of the moderate ones, ultrasonic therapy well applied improves subjective symptoms: relief from nocturnal pain, then from pain in walking. Articular mobility will improve as long as its limitation is caused by functional disturbances. Even if articular destruction as seen on radiographs cannot be reversed into the status quo ante, a succession of skiagrams will sometimes show an improvement of some of the lesions: pseudo-cysts in the bone or erosion of the articular surface. The picture of these cases is one of healing and sclerosis. Given the anatomical character of the lesions, clinical recovery will not exceed a certain extent. Benefit of treatment will last for from a few months to two years. Treatment repeated at regular intervals will keep results steady in most cases. Comparison of ultrasonic therapy with other conservative treatment allows us to consider this therapy as one of the best conservative methods at our disposal today.

The Present State of Ultrasonic Therapy. V. Buchtala.

Brit. J. Phys. Med. **15**:3 (Jan.) 1952.

Clinical experience has shown that ultrasonic therapy is useful for the following: (1) Neuralgic conditions, with sciatic neuritis of particular importance; (2) inflammatory conditions of the soft parts of the body (alleviation or abolition of pain follows rapidly upon the first application of ultrasonics in more than 50 per cent of the cases); (3) painful diseases of joints, which constitutes the main indication for the use of ultrasonics and includes conditions with or without arthritis deformans; (4) follow-up treatment of fractures, especially those which have healed without complication. On an average six sonations restore normal mobility, particularly when they are combined with the usual physical therapy; (5) peripheral circulatory disorders, which react well to ultrasonics if they have a neural (spastic) background. Peripheral circulatory disorders such as Buerger's or Raynaud's disease respond to this treatment with an improvement which lasts for up to six months; (6) asthma bronchiale, which usually can be favorably influenced by ultrasonics; but chronic conditions of this group are hardly ever entirely eliminated, and (7) peptic ulcers. There is much difference of opinion as to the value of ultrasonic therapy for gastric and duodenal ulcers. Ultrasonic treatment sounds convincing; however, suggestions for ultrasonic therapy for peptic ulcers should be made with reserve, for the spontaneous relief from pain may mask an acute case which should not be sonated.

After some years of experience the general opinion is that ultrasonics offer an effective form of physical therapy which in trained hands involves no dangers of delayed adverse effects corresponding to x-ray effects. As to the more acute damage, it is, of course, essential that the therapist be familiar with the relevant laws of physics. A few specific contra-indications should be mentioned. Malignant tumors, which were regarded as a hopeful field of ultrasonic therapy, actually represent a strict contra-indication. The ganglion stellatum must not be exposed to ultrasonics in cases of disorders of the heart or in subjects with unstable hearts, because it may cause prolonged states of depression and temporary paroxysmal tachycardia. Heart failure has been reported. Infants should not be subjected to ultrasonics, since the developing bones may respond with disturbances of development. The pregnant uterus must not be sonated, though the experiments by Thiele who reported abortions in pregnant mice exposed to ultrasonics were not sup-

ported by the investigations of other authors or by the experience of Buchtala. Similarly, it has been stated that the ovary was readily damaged by ultrasonics. A more general danger may arise from disregarding the subjective sensations which the patient may report. Excessive intensities or excessive dosage may cause blistering of the skin, but even in such cases lesions of deeper layers have not often been recorded.

Manipulation of the Lumbosacral Joint. Edmund H. Schweitzer.

Ohio State M. J. **47**:930 (Oct.) 1951.

The typical patient in which it is our feeling that manipulation is indicated is one who walks into the office or is seen in the outpatient department of the hospital giving a history that on two, three or four days previously, he had been bending over just picking up some object. Ordinarily the object is not heavy and is of no significance. On picking it up in a certain twisting maneuver of the low back, the patient feels a snap in the back below the belt line and on rising he has immediate pain in the part which is identified as the lumbosacral joint. He has been unable to completely extend the lumbar spine and hyperextension of the back causes pain and a great amount of discomfort. Ordinarily he has tried some conservative treatment at home such as heat or warm baths or massage to the back but has obtained very little if any relief from these conservative measures. The usual history is that he has not had any symptoms before and that this is the original complaint with him. It is not felt that manipulation of the lumbosacral joint can be gone into lightly and cannot be used routinely in low back pain problems. The cases have to be selected very carefully and they have to fall into a certain pattern as far as history, acuteness and physical findings are concerned, and must by all means have ruled out the possibility of skeletal pathology in the lumbosacral area such as spondylolisthesis or spina bifida or lumbarization of the first sacral vertebra, and many of the other congenital anomalies which sometimes will give complicating pictures in this type of case. The procedure is convincing after sixteen cases have been seen in which they were back cripples one day and the next day thirteen were complaining of very little if any pain, and were able to stand erect without backache. Many of our cases were industrial cases and tying them up with traction devices, diathermy and heating pads would delay their return to work and also encumber their earning power for a period of weeks or months. It is thought that from an economical standpoint and from a practical standpoint that the patient's ability to return to work four or five days after the manipulation is much to his benefit. In some of these cases there is going to be failure to help the patient; these will require further study with neurosurgical consultation and myelography will be necessary. But in the majority, orthopedic manipulation will bring about the desired results. In competent hands when the cases have been worked up carefully, x-rays studied thoroughly, there should be no reason for complications from the actual manipulative procedure.

Certain Procedures for the Surgical Rehabilitation of the Hand in Poliomyelitis. Thomas Gucker, III.

J. Missouri M. A. **49**:227 (Mar.) 1952.

Most patients afflicted with poliomyelitis look forward anxiously to the time when they can walk again and get about in a normal manner, since one usually thinks of paralysis in poliomyelitis as producing cripples because of involvement of the lower extremities. However, almost without exception adequate use of the hands is by and large much more necessary for the patient's ultimate employability and over-all happiness. From the time of onset of weakness of true paralysis involving the forearm and hand, the first consideration must be given to the maintenance of normal alignment of the thumb, fingers and wrist and the prevention of progressive contractures followed by fixed deformity of the bones of the hand. Too much emphasis cannot be placed on the need for properly fitting splints which maintain the hand, fingers and thumb in a position of function. Such splints should be worn all night and as much of the day as necessary to prevent progressive contractures. Motion of all joints must be instituted as soon as tolerated and increasing mobility should be gained by carefully planned daily passive and active movements to maintain joint mobility. In a large measure the ultimate functional use of the hand depends directly on the adequacy of care during the first few months following paralysis from poliomyelitis. The most successful program for rehabilitation requires that there be continued coordination and cooperation between all those who are at the onset or subsequently will be responsible for the several aspects of the patient's over-all treatment program.

D-491 F.C.C. TYPE APPROVED

The New

MASTER FISCHERTHERM

model 1200

NEW FCC APPROVED DIATHERMY

APPROVED BY BOARD OF BUILDING AND SAFETY COMMISSIONERS, CITY OF LOS ANGELES.

Department of Transport, Canada, Radio Division Listed No. 47

R. A. FISCHER & CO.

517 COMMERCIAL STREET, GLENDALE 3, CALIF.

write for descriptive literature

Manufacturer of **ELECTRO-THERAPY EQUIPMENT**

fischer

Are appearing in January, 1953:

I

THE PLURIPOTENCY OF THE HYPOPHYSEAL HORMONES
and the consequences for
ENDOCRINOLOGY AND CANCEROLOGY
by
Dr. JULES SAMUELS, AMSTERDAM

This book is
A PIONEER
FOR MEDICAL SCIENCE AND PROFESSION
Price: bound, 37 guilders (plus f 1. — postage)

II

FOURTH REVISED EDITION
of
ENDOGENOUS ENDOCRINOTHERAPY
including
THE CAUSAL CURE OF CANCER COMPENDIUM
by
Dr. JULES SAMUELS, AMSTERDAM
Price: bound, 32 guilders (plus f 1. — postage)

Publishers: N. V. CYCLOSCOOP
HONTHORSTSTR. 22, AMSTERDAM
Bank: TWENTSCHE BANK
SPUISTR. 128-150, AMSTERDAM-C.

CHICAGO SOCIETY OF PHYSICAL MEDICINE AND REHABILITATION

Wednesday, March 25, 1953

Dinner, 6:30 P. M., Nurses Dining Room, Building 108, VA Hospital, Hines, Ill.

Scientific Session, 8:00 P. M., Vaughan Theater, Building 170.

Subject: "Physical Medicine and Rehabilitation in Tuberculosis and Chest Surgery." Louis B. Newman, M.D., Chief, Physical Medicine and Rehabilitation Service, and Associates.

Make reservations with the Secretary-Treasurer, Dr. I. F. Hummon, 30 N. Michigan Ave., Room 1429, Chicago 2.

APPROVED SCHOOLS OF PHYSICAL THERAPY **

Council on Medical Education and Hospitals of the American Medical Association

Name and Location of School	Medical Director and Technical Director	Entrance Requirements [1]	Duration of Course	Classes Begin	Maximum Enrolment	Tuition	Certificate, Diploma, Degree
U. S. Army Medical Service							
(Address all inquiries to the Office of the Surgeon General, Department of the Army, Washington 25, D.C.)		e	49 wks.	Mar.-Sept.	26	None	Certificate
Medical Field Service School, Brooke Army Medical Center, Fort Sam Houston, Texas, and Brooke, Walter Reed and Letterman Army Hospitals	Charles D. Shields, Lt. Col., M.C., and Vann S. Taylor, Major, M.C.	Affiliated with Medical Field Service School					
	Agnes P. Snyder, Major, WMSC	Affiliated with Medical Field Service School					
Nonfederal							
Childrens Hospital, Los Angeles*	S. S. Matthews, M.D. Mrs. Mary J. Dodge	a-b-d	14 mos.	Sept	14	$300	Cert. or Degree
College of Medical Evangelists, Los Angeles*	F. B. Moor, M.D. R. Wm. Berdan	a-b-e	15 mos.	Sept	16	$300	Cert. or Degree
University of Southern California, Los Angeles*	C. L. Lowman, M.D.	a-b-d	14 mos.	Sept	16	Univer.	Certificate
University of California School of Medicine, San Francisco*	Charlotte W. Anderson Lucile Eising, M.D.	f d	4 yrs. 12 mos.	FebSept Sept	6 16	Univer. $220[2]	Cert. & Degree Cert. or Degree
Stanford University, Stanford University, Calif.*	Margery L. Wagner W. H. Northway, M.D.	a-d-e	12 mos.	Varies	29	$690	Certificate
University of Colorado Medical Center, Denver*	Lucille Daniels Harold Dinken, M.D.	f a-b-d	4 yrs. 12 mos.	Sept Sept	16 12	$220 qr. $208[3]	Degree Cert. or Degree
University of Connecticut, Storrs*	Dorothy Hoag John C. Allen, M.D.	c-f	2-4 yrs.	FebSept	....	$150[2]	Degree
Northwestern University Medical School, Chicago	Frances M. Tappan E. D. W. Hauser, M.D.	a-b-d	12 mos.	Oct	16	$450	Certificate
State University of Iowa College of Medicine, Iowa City*	Elizabeth C. Wood W. D. Paul, M.D.	e	12 mos.	Sept	20	$200	Certificate
University of Kansas Medical Center, Kansas City, Kan.*	Olive C. Farr D. L. Rose, M.D.	d	12 mos.	FebSept	3	$40[2]	Certificate
Simmons College, Boston	Ruth G. Monteith W. T. Green, M.D.	f a-e	4 yrs. 16 mos.	FebSept Sept	9 24	$40[2] College	Degree Diploma
Boston University College of Physical Education for Women, Sargent College, Cambridge, Mass.	Shirley M. Cogland Kenneth Christophe, M.D.	f c-d-e-f	4½ yrs. 1-2-4 yrs.	Sept Sept	30	Univer.	Degree Cert. or Degree
Bouve-Boston School in affiliation with Tufts College, Medford, Mass.	Adelaide L. McGarrett Howard Moore, M.D.	f	4 yrs.	Sept	16	$550	Dipl. & Degree
University of Michigan, Ann Arbor.*	Constance K. Greene James W. Rae, Jr., M.D.	a-b-c-d-e-f	1-4 yrs.	June	16	$30 semes.[3]	Cert. & Degree
University of Minnesota, Minneapolis*	Virginia Wilson F. J. Kottke, M.D.	c	2 yrs.	Sept	20	$126	Degree
Mayo Clinic, Rochester, Minn.*	Ruby Green Overmann E. C. Elkins, M.D.	a-b-c	2 yrs.	Sept	38	$250	Certificate
St. Louis University, Division of Health and Hospital Services, St. Louis*	Harry Keown A. J. Kotkis, M.D.	f	4 yrs.	JanSept	12	$175 Semes.	Degree
Washington University School of Medicine, St. Louis*	Sister Mary Imelda Sedgwick Mead, M.D.	c	2 yrs.	Sept	16	$450 1st yr.[4] $325 2d yr.[4]	Degree
Albany Hospital, Albany, N. Y.	Beatrice F. Schulz J. W. Ghormley, M.D.	a-b-d	12 mos.	Sept	6	$300	Certificate
University of Buffalo, Buffalo, N. Y.	Catharine Graham Henry V. Morelewicz, M.D.	f d-f	4 yrs. 1-4 yrs.	Sept Sept	20	$500 $550	Degree Cert. & Degree
Columbia University College of Physicians and Surgeons, New York City*	Mildred F. Heap W. B. Snow, M.D.	a-c-e	1-2 yrs.	Sept	50	$680 (1 yr.) $1,200 (2 yrs.)	Cert. or Degree
New York University School of Education, New York City*	Mary E. Callahan G. G. Deaver, M.D.	a (+1 yr. coll.) b-d	12 mos.	Sept	40	$760	Cert. & Degree
Duke University, Durham, N. C.*	Elizabeth C. Addoms L. D. Baker, M.D.	a-b-d	15 mos.	Oct	12	$350	Certificate
Frank E. Bunts Educational Institute, affiliated with The Cleveland Clinic Foundation, Cleveland*	Helen Kaiser Paul A. Nelson, M.D.	a-b-c	12 mos.	Oct	16	$225	Certificate
D. T. Watson School of Physical Therapy, Leetsdale, Pa.*	Dorothy Spark Jessie Wright, M.D.	a-b-d	12 mos.	Oct	25	$300	Diploma
Divison of Physical Therapy of the School of Auxiliary Medical Services of the University of Pennsylvania, Philadelphia*	Kathryn Kelley G. M. Piersol, M.D.	e f	12 mos. 4 yrs.	FebSept Sept	32 40	$600 $600	Certificate Cert. & Degree
Baylor Hospital, Dallas, Texas	Edward M. Krusen, Jr., M.D.	a-b-c	12 mos.	Sept	12	$300	Certificate
University of Texas School of Medicine, Galveston*	Peggy J. Dyer G. W. N. Eggers, M.D.	a-b-d	12 mos.	Jan	8	$149[2]	Cert. or Degree
Hermann Hospital, Houston, Texas*	Ruby Decker O. O. Selke, Jr., M.D.	a-b-d	12 mos.	Oct	15	$300	Certificate
Baruch Center of Physical Medicine and Rehabilitation, Medical College of Virginia, Richmond*	Elizabeth Barkley Herbert Park, M.D.	a-b-d	12 mos.	Sept	62	$300[2]	Diploma
University of Wisconsin Medical School, Madison*	Susanne Hirt H. D. Bouman, M.D.	f a-b-d	4 yrs. 12 mos.	Sept Sept	22	$60	Degree Certificate
	Margaret A. Kohli	f	4 yrs.	FebSept	20	Semes.[1]	Cert. & Degree

** Reprinted in part J. A. M. A. 146:197 (May 12) 1951.

1. Courses are so arranged that any of the entrance requirements will qualify students for training. a — Graduation from accredited school of nursing; b — Graduation from accredited school of physical education; c — Two years of college with science courses; d — Three years of college with science courses; e — Four years of college with science courses; f — High school graduation.

2. Nonresidents charged additional fee.

* Male as well as female students admitted.

3. Effective July 1, 1952, tuition will be $262.50 for each of the first three semesters, and $112.50 for the fourth semester, making a total of $900.00 for two years.

APPROVED SCHOOLS OF OCCUPATIONAL THERAPY **

Council on Medical Education and Hospitals of the American Medical Association

Name and Location of School	Director and Medical Director	Entrance Requirements	Duration of Course[1]	Classes Begin	Tuition per Year	Certificate, Diploma, Degree
University of Southern California, Los Angeles*	Margaret S. Rood	Degree	18 mos.	Varies	$594	Certificate
	J. B. Armstrong, M.D.	High sch.	5 yrs.	Varies	$540	Cert. & Deg.
Mills College, Oakland, Calif.	Elsa H. Hill	Degree	2½ yrs.	FebSept	$250	Certificate
		High sch.	4 yrs.	FebSept	$650	Cert. & Deg.
San Jose State College, San Jose, Calif.*	Mary D. Booth	Degree	18 mos.	Varies	$ 28.50	Certificate
	Charles Ianne, M.D.	High sch.	46 mos.	Varies	$ 28.50	Cert. & Deg.
Colorado Agricultural and Mechanical College, Fort Collins, Colo.*	Marjorie Ball	Degree	2 yrs.	Varies	$147[2]	Certificate
	W. R. Conte, M.D.	High sch.	5 yrs.	Varies	$181[2]	Cert. & Deg.
University of Illinois College of Medicine, Chicago*	Beatrice D. Wade	High sch.	5 yrs.	MarSept	$110	Degree
	S. W. Olson, M.D.					
State University of Iowa, Iowa City*	Elizabeth Huntsberry		19 mos.	FebSept	$ 78[2]	Certificate
	W. M. Fowler, M.D.	High sch.	46 mos.	FebSept	$ 78[2]	Cert. & Deg.
University of Kansas, Lawrence	Nancie B. Greenman	High sch.	45 mos.	FebSept	$110[2]	Degree
	D. L. Rose, M.D.					
Boston School of Occupational Therapy, 7 Harcourt St., Boston*	Marjorie B. Greene	Degree	2 yrs.	Sept	$500	Certificate
	A. W. Reggio, M.D.	High sch.	5 yrs.	Sept	$500	Degree
Wayne University, Detroit*	Barbara Jewett	Degree	19 mos.	Varies	$150	Certificate
	F. A. Weiser, M.D.	High sch.	46 mos.	Varies	$150	Degree
Kalamazoo School of Occupational Therapy, Kalamazoo, Mich.*	Marion R. Spear	Degree	18 mos.	FebSept	$ 75[2]	Certificate
	Donald May, M.D.	1 yr. coll.	4 yrs.	FebSept	$ 75[2]	Cert. & Deg.
Michigan State Normal College, Ypsilanti, Mich.*	Frances Herrick	High sch.	5 yrs.	Sept	$140[2]	Cert. & Deg.
	J. W. Rae, Jr., M.D.					
University of Minnesota, Minneapolis*	Borghild Hansen	High sch.	40 mos.	Sept	$149.55	Degree
	F. J. Kottke, M.D.					
College of St. Catherine, 2004 Randolph Ave., St. Paul	Sister Jeanne Marie	Degree	16 mos.	Varies	$240	Degree
	J. M. Ryan, M.D.	High sch.	5 yrs.	Varies	$240	Degree
Washington University School of Medicine, St. Louis*	Erna L. Rozmarynowski	Degree	19 mos.	Sept	{ Univer-	Certificate
	R. A. Moore, M.D.	2 yrs. coll.	28 mos.	Sept	} sity	Degree
University of New Hampshire, Durham*	Esther Drew	High sch.	5 yrs.	Sept	$250[2]	Cert. & Deg.
	J. A. MacDonald, M.D.					
Columbia University College of Physicians and Surgeons, New York City*	Marie L. Franciscus	Degree	17 mos.	Sept	$600	Certificate
	W. B. Snow, M.D.	2 yrs. coll.	27 mos.	Sept	$600	Degree
New York University School of Education, New York City*	Frieda J. Pehlen	1 yr. coll.		FebSept	{ Univer-	Certificate
	John Sawhill, M.D.	High sch.	4½ yrs.	FebSept	} sity	Cert. & Deg.
Ohio State University, Columbus*	Barbara Locher	High sch.	4 yrs.	Varies	University	Degree
	R. E. Worden, M.D.					
Philadelphia School of Occupational Therapy of the School of Auxiliary Medical Services of the University of Pennsylvania, Philadelphia*	Helen S. Willard	Degree	18 mos.	Sept	$600	Certificate
	J. C. Yaskin, M.D.	High sch.	5 yrs.	Sept	$600	Cert. & Deg.
Texas State College for Women, Denton	Fanny B. Vanderkooi	Degree	18 mos.	FebSept		Certificate
	O. T. Woods, M.D.	High sch.	5 yrs.	FebSept	$ 50[2]	Degree
Richmond Professional Institute, 901 W. Franklin St., Richmond, Va.*	H. Elizabeth Messick	Degree	10-18 mos.	FebSept	$182+	Certificate
	I. E. Barrett, M.D.	High sch.	5 yrs.	Sept	$200	Degree
College of Puget Sound, N. 15th and Warner Sts., Tacoma, Wash.*	Edna-Ellen Bell	1-4 yrs. coll.	2-3 yrs.	Jan-Sept	$350	Certificate
	T. H. Duerfeldt, M.D.	High sch.	5 yrs.	Jan-Sept	$350	Cert. & Deg.
University of Wisconsin, Madison*	Caroline G. Thompson	High sch.	5 yrs.	Sept	$150[2]	Cert. & Deg.
	H. D. Bouman, M.D.					
Milwaukee-Downer College, Dept. of Occupational Therapy, 2512 E. Hartford Ave., Milwaukee	Henrietta W. McNary	2 yrs. coll.	3 yrs.	Sept	$350	Certificate
	M. C. Borman, M.D.	High sch.	5 yrs.	Sept	$350	Degree
Mount Mary College, 92d and Burleigh, Milwaukee	Sister Mary Arthur	High sch.	5 yrs.	Sept	$310	Cert. & Deg.
	J. C. Griffith, M.D.					

** Reprinted J. A. M. A. 146:198 (May 12) 1951. [Revised to May 10, 1952.]

1. Duration of course is expressed in academic years or in number of months.

2. Nonresidents charged additional fee.

* Male as well as female students admitted.

PHYSICAL MEDICINE AND REHABILITATION **

The following services are approved by the Council on Medical Education and Hospitals, and the American Board of Physical Medicine and Rehabilitation. Residencies in this specialty have been approved without specifying the number of years for which they are accredited. The Board will give appropriate credit for training in these hospitals on an individual basis.

Hospitals, 45; Assistant Residencies and Residencies, 87.

Name of Hospital	Location	Chief of Service	Inpatients Treated	Number of Treatments	First Year Residencies Offered[3]	Total Residencies Offered[3]	Beginning Stipend (Month)
UNITED STATES ARMY							
Letterman Army Hospital★	San Francisco	R. C. Psaki	4,231	116,264	....	....	.....
Fitzsimons Army Hospital★	Denver	H. B. Luscombe	7,045	250,440	....	....	.....
Army Medical Center★	Washington, D. C.	J. H. Kuitert	5,224	344,228	1	4	.....
VETERANS ADMINISTRATION							
Veterans Admin. Hospital★[1,2]	Long Beach, Calif.	Roy H. Nyquist	3,305	182,286	1	1	.....
Veterans Admin. Hospital[1,2]	Denver	C. C. Hoffman	731	11,804	1	1	.....
Veterans Admin. Hospital[1]	Hines, Ill.	L. B. Newman	5,135	463,131	4	4	.....
Veterans Admin. Hospital[1,2]	Wadsworth, Kan.	L. Blau	2,471	174,247	1	2	.....
Veterans Admin. Hospital[1,2]	Framingham, Mass.	F. Friedland	7,100	214,000	1	3	.....
Veterans Admin. Hospital[1,2]	New York City	A. S. Abramson	4,196	302,119	1	3	.....
Veterans Admin. Hospital[1,2]	Cleveland	H. T. Zankel	1,646	78,194	1	1	.....
Veterans Admin. Hospital[1,2]	Portland, Ore.	E. W. Fowlks	4,309	112,456	1	2	.....
Veterans Admin. Hospital[1]	Aspinwall, Pa.	S. Machover	1,957	56,412	1	1	.....
Veterans Admin. Hospital[2]	Memphis, Tenn.	F. I. Mahoney	10,090	152,031	....	....	.....
Veterans Admin. Hospital★[1,2]	Houston, Texas	B. L. Boynton	1,682	60,589	1	2	.....
Veterans Admin. Hospital★[1,2]	Milwaukee	R. Piaskoski	16,084	209,092	....	....	.....
NONFEDERAL							
Los Angeles County Hospital★[1,2]	Los Angeles	E. Austin	.....	93,906	....	1	173
White Memorial Hospital★[1,2]	Los Angeles	F. B. Moor	39,608	39,608	1	1	132
University of Colorado Medical Center Colorado General Hospital★[1,2]	Denver	H. Dinken	2,177	38,381	1	2	150
State of Connecticut Veterans Home and Hospital[1,2]	Rocky Hill, Conn.	N. K. Covalt	663	63,375	....	3	253.34
George Washington University Hospital[1,2]	Washington, D. C.	C. S. Wise	2,433	15,563	....	....	130
Emory University Hospital★[1,2]	Emory Univ., Ga.	R. L. Bennett	1,001	15,846	....	1	250
Georgia Warm Springs Foundation[1,2]	Warm Springs, Ga.	R. L. Bennett	998	114,110	1	4	250
Michael Reese Hospital★[1,2]	Chicago	C. Molander	3,589	30,929	1	1	25
Northwestern University Medical Center[1,2]	Chicago	.....	13,752	43,409	....	....	50
Research and Educational Hospitals★[1,2]	Chicago	F. A. Hellebrandt	12,266	12,266	1	3	60
University of Kansas Medical Center★[1,2]	Kansas City, Kan.	D. Rose	2,563	49,649	....	1	125
Massachusetts General Hospital★[1,2]	Boston	A. L. Watkins	3,039	33,483	....	2	66.67
University Hospital★[1]	Ann Arbor, Mich.	J. W. Rae, Jr.	.....	20,659	2	6	134.16
University of Minnesota Hospitals★[1,2]	Minneapolis	F. J. Kottke	14,007	25,194	2	6	142.50
Mayo Foundation[1,2]	Rochester, Minn.	F. H. Krusen	.....	.....	2	6	150
Barnes Hospital★[2]	St. Louis	S. Mead	9,572	9,572	....	1	25
Bellevue Hospital Center—Division III—New York University College of Medicine★[1,2]	New York City	H. A. Rusk	1,082	83,147	4	7	80
Goldwater Memorial Hospital★[1,2]	New York City	M. Dacso	674	44,446	1	2	90
Hospital for Joint Diseases★[1,2]	New York City	J. Weiss	.....	90,407	1	2	60
Hospital for Special Surgery[2]	New York City	K. G. Hansson	19,388	37,284	1	1	160
Metropolitan Hospital[1,2]	New York City	J. Tobis	1,023	24,788	....	....	.....
Mount Sinai Hospital★[1,2]	New York City	W. Bierman	8,464	32,947	1	1	50
New York City Hospital★[1,2]	New York City	F. K. Safford, Jr.	1,030	37,080	1	1	160
Presbyterian Hospital★[1,2]	New York City	R. C. Darling	5,011	175,061	1	3	208.33
St. Luke's Hospital★[1,2]	New York City	R. Muller	1,099	115,572	1	1	60
Rehabilitation Hospital[1,2]	West Haverstraw, N. Y.	M. Hoberman	517	332,205	1	1	225
Cleveland Clinic Hospital[1,2]	Cleveland	W. J. Zeiter	16,638	36,957	1	3	150
University Hospitals Ohio State University Hospital[1,2]	Columbus, Ohio	R. E. Worden	1,245	15,894	....	....	425
Hospital of the Univ. of Pennsylvania★[1,2]	Philadelphia	G. Piersol	2,771	45,549	....	1	.....
Philadelphia General Hospital★[1,2]	Philadelphia	A. Martucci	1,225	66,802	2	2	112

The Star (★) indicates hospital approved for intern training.
1 Residencies open to women.
2 Available to graduates of foreign medical schools.
3 Includes fellowships.
** Reprinted in part J. A. M. A. 150:339 (Sept. 27) 1952.

ARCHIVES AVAILABLE ON MICROFILM

The ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION is now available to libraries on microfilm. A microfilm edition will be sold only to bona fide subscribers of the ARCHIVES, is not for resale and will be distributed at the end of the volume year.

For further information, inquiry should be directed to UNIVERSITY MICROFILMS, 313 North First Street, Ann Arbor, Mich.

MEETINGS OF INTEREST TO THOSE IN THE FIELD OF PHYSICAL MEDICINE AND REHABILITATION

In this column will be published information about meetings of interest to those in the field of physical medicine. New data should be sent promptly to the office of the ARCHIVES, 30 North Michigan Avenue, Chicago 2, Illinois.

American Congress of Physical Medicine and Rehabilitation — 31st Annual Session, The Palmer House, Chicago, August 31 through September 4, 1953. Walter J. Zeiter, M.D., Chairman, Convention Committee, 30 North Michigan Ave., Chicago 2.

Chicago Society of Physical Medicine and Rehabilitation — Regular monthly meetings, September through May, every fourth Wednesday. Dr. I. F. Hummon, Secretary-Treasurer, 30 N. Michigan Ave., Room 829, Chicago.

New York Society of Physical Medicine — Monthly meetings held First Wednesday. Madge C. L. McGuinness, M.D., Secretary, 48 E. 62nd St., New York 21, N. Y.

Pennsylvania Academy of Physical Medicine and Rehabilitation — Regular meetings on third Thursday of month, held bi-monthly. Secretary-Treasurer, J. Murl Johnston, M.D., 694 Washington Rd., Pittsburgh 28, Pa.

American Occupational Therapy Association — Annual Conference, November 13-20, 1953, Shamrock Hotel, Houston, Texas. Marjorie Fish, OTR, Executive Director, 33 West 42nd Street, New York 18, N. Y.

American Physical Therapy Association — Annual Conference, June 15-19, Baker Hotel, Dallas, Texas. Mildred Elson, Executive Director, 1790 Broadway, New York 19, N. Y.

International

World Congress of the World Confederation for Physical Therapy — London, England, September 7-12, 1953. Secretary, Miss M. J. Neilson, Chartered Society of Physiotherapy, Tavistock House, South, Tavistock Square, London, W.C. 1, England.

Vaso-Pneumatic

OPERATE DISTALLY:
To increase arterial blood flow.

OPERATE PROXIMALLY:
To increase venous and lymphatic return.

A series of quickly applied Neoprene cuffs are automatically inflated and deflated to produce a band of pressure that progresses up or down the arm or leg with a PERISTALTIC MOTION.

Usual treatment time 15 minutes.

Send for further information

POOR & LOGAN MFG. CO.
7319 VARNA AVE., NORTH HOLLYWOOD, CALIF.

When muscles ache or joints are stiff...

Gratifying, prolonged relief from discomfort due to—

lumbago,
muscle pains,
sprains,
painful joints,
stiffness after exercise.

'Menthofax' is an aromatic analgesic ointment containing a high concentration (40%) of methyl salicylate in a base which facilitates application and favors absorption.

'Menthofax'®

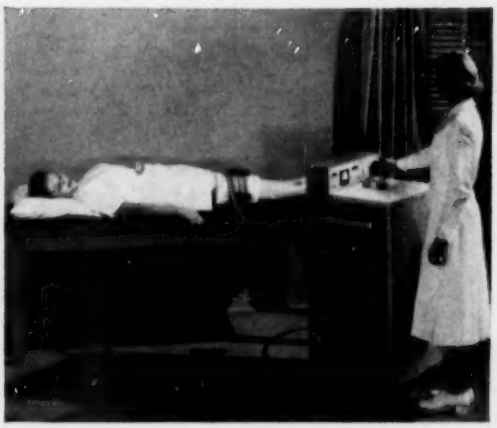
Rubefacient-Analgesic

Supplied in collapsible tubes of 1 oz.

Burroughs Wellcome & Co. (U.S.A.) Inc., *Tuckahoe 7, New York*

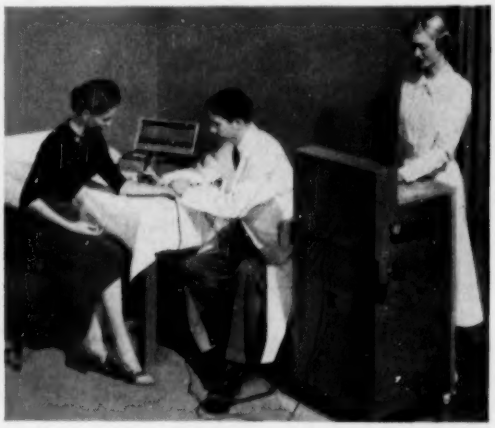
GE Model F Inductotherm brings new ease and facility to diathermy

1 **CONTOUR** — Fully adjustable contour-following electrode is part of the basic unit. It's extremely versatile, easily and quickly applied.



2 **CABLE**— Optional is the 12-ft treatment cable for treating larger areas. Note how electrodes attach conveniently in the rear of the unit.

3 **AIR SPACE** — Also available: fully adjustable air-spaced condenser-type electrodes, including extra supporting arm and bracket.



4 **ELECTROSURGICAL** — Built-in surgical facilities meet all medium and light requirements. Optional: electrosurgical kit for extended usefulness.

Yes, it's simple to get the desired quality and intensity for any diathermy treatment with the new GE Model F Inductotherm. Output has been raised to 200 watts — plus. And the unit is crystal-controlled for absolute adherence to government-approved frequency. Get all the facts about the handsome, mobile Model F from your GE x-ray representative, or write X-Ray Department, General Electric Company, Milwaukee 1, Wisconsin, for your copy of Pub. O-2.

1878 75 1953
YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

AFTER JULY 1, 1953...

ALL DIATHERMIES MUST BE FCC APPROVED

or otherwise meet new FCC requirements

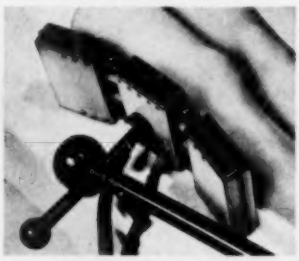
Don't put off replacing your old machine!

Only BIRTCHER

S. W. Diatherms Have the THREE-WAY TRIPLE INDUCTION DRUM

The Triple Drum is adjustable for both convex and concave surface.

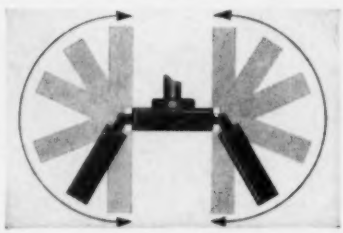
Triple Drum goes around shoulder, applies heat on three surfaces.



Triple Drum may be adjusted to cover knee and areas above and below it.

The Triple Induction Drum provides safe, *effective* application to all parts of the body and may be adjusted to conform to every contour — concave and convex.

Be sure to see the Birtcher Challenger or Bandmaster before you buy any short wave diatherm for office or clinic.



Literature on request.

Illustrated booklets "The Simple Story of Short-Wave Therapy," "The Large Area Technic" and Illustrated Treatment Chart are available . . . simply fill in and mail the coupon.

Dept. APM & R: 2-53

To: The Birtcher Corporation,
4371 Valley Blvd., Los Angeles 32, California

Dr._____

Street_____

City_____ State_____

THE BIRTCHER CORPORATION · 4371 Valley Blvd., Los Angeles 32, Calif.